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ABSTRACT

This handbook was designed to help counselors and career development personnel to adopt and adapt to using microcomputers. The 18 papers included in the handbook were written by a cross section of career and counseling professionals as well as experts in microcomputer applications. In the first section of the handbook, the authors examine the general use of microcomputers in education and in career development. Important issues related to these topics are presented, and initiatives for instruction, counseling, and administrative tasks are described. The second section focuses on the areas, services, and programs pertinent to career counseling and career selection. The role of the microcomputer is examined with specific information provided and applications specified for the career counseling program. Topics covered in the book include the following: computer literacy, buying hardware and software, designing software, administrative use of the microcomputer, using microcomputers with special needs students, career information and the microcomputer, job simulation on the microcomputer, computerized career planning inventories, career exploration, and emerging careers. Short biographies of the contributors complete the text. (KC)

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MICROCOMPUTERS: APPLICATIONS IN CAREER COUNSELING AND CAREER EDUCATION

Editors:

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INTRODUCTION

Microcomputers in the field of career counseling are a new phenomena. Only in the past year or two have significant numbers of counselors and career education personnel discovered the microcomputer for career development purposes. While microcomputers are a household word and rapidly becoming an essential fixture in the classroom, the counseling area is just beginning to tap its potential. As this potential is discovered and as programs are developed to maximize its capabilities, the microcomputer will revolutionize the career guidance functions just as it is doing in many classrooms and in everyday business.

Most counselors and career development specialists will utilize the microcomputer in the future for information storage and retrieval, scheduling, report generation, recordkeeping, and, of course, counseling. These users will change the way a counselor works; they will place new demands on counselors for upgrading their skills and, at the same time, will enable counselors to be more effective with more students.

Helping counselors and career development personnel adopt and adapt to microcomputers is the primary purpose of this Handbook. It is envisioned as a tool to aid in the transition and reduce the stress as well as the time required to make the necessary adjustments. The first section of the Handbook will examine the general use of microcomputers in education and in career development. Authors of this section have presented important issues related to the topic as well as describing the initiatives for instruction, counseling, and administrative tasks.

The second section of this Handbook focuses on the areas, services, and programs pertinent to Career Counseling/Career Selection. The role of the microcomputer is examined with specific information provided and applications in the career counseling program.

The authors of the chapters in this book represent a cross section of career and counseling professionals as well as experts in microcomputer applications.

The topics covered in the book include:

- Computer Literacy
- Buying Hardware and Software
- Designing Software
- Administrative Use of the Microcomputer
- Using Micros with Special Needs Students
- Career Information and the Microcomputer
- Job Simulation on the Microcomputer
- Computerized Career Planning Inventories
- Career Exploration
- Emerging Careers.

Roger Lambert, Ph.D., Editor

Judith Rodenstein, Ph.D., Editor

COMPUTER LITERACY*

by Daniel L. Klassen and Ronald E. Anderson

Introduction

During the past decade, computer technology has come to play a very important, often pivotal, role in American scientific, business, industrial, and governmental institutions. Efforts to improve productivity, increase efficiency and service, and to cope with the "information explosion" have spawned thousands of uses for computers. Our nation, it has been observed, has been transformed from an industrial society into an information society that relies heavily on computers and related information systems (11). According to a recent government report, the largest single class of employees in the United States today have jobs dealing, in the broadest sense, with information processing and communications, and it is well known that computer technology has influenced these areas extensively (45). In addition to the many known uses of computers, it is estimated that there are thousands of applications of the computer still awaiting discovery. As a recent TIME article put it, "Amazing feats of memory and execution become possible in everything from automobile engines to universities and hospitals, from farms to banks and corporate offices, from outer space to a baby's nursery" (15). To ask what these applications are is like asking what are the applications of electricity. There is little doubt, it seems, that life in the United States and in the rest of the industrial world, and eventually all over the planet, will be incalculably changed by computer technology.

Need For Computer Literacy

In an information society such as ours, widespread understanding of computer technology and the consequences of computer use and misuse is necessary, even required, for public policymaking. A lack of understanding and acceptance of computers could seriously impede the use of computer technology

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in solving important problems. Many observers of the role of computer technology in society believe that if the gap between current technological capacity and the ordinary person's understanding of the technology is allowed to grow too wide, the social and political, as well as scientific, ramifications are likely to be very serious (36). Special concern about computers and information systems is justified because of their unique features and their close association with large bureaucratic institutions and the enterprise of science.

For the individual, an understanding of computer technology and uses is important because it reduces bewilderment about computers and promotes a balanced view of the computer's role in society. Such understanding also enables people to use and influence the design of computer-based social services and to develop informed opinions regarding particular computer applications having political, economic, and social implications.

Public understanding of computers and their applications has not kept pace with their availability and use. The AFIPS/TIME survey in 1971 showed that public attitudes are often unrealistic and negative, and understanding of computers is sometimes incorrect. The young, who have grown up in the "computer age" are not much better informed. The recently conducted Minnesota computer literacy study found that most junior and senior high school students know very little about computers and their implications for society (27). Furthermore, most students do not understand the general limitations of computers. For instance, over half of the 1,500 students tested believe that "computers help people make decisions by providing correct answers to any question." Whereas those with no prior exposure to computers were more likely to give the incorrect response to this item, 43 percent of the students with computer programming experience also answered incorrectly. Answers to many other questions showed a similar lack of understanding and awareness. It is clear from this and other research (7) that students lack realistic views and basic knowledge of computers and that mere exposure to computers does not automatically eradicate misconceptions.

The growing recognition of the importance of widespread public understanding of computers in an information/computer society has prompted concerned educators to urge the launching of educational efforts to eliminate, or at least reduce, computer illiteracy. The President's Science Advisory Committee and the Organization for Economic Cooperation and Development, in the late 1960's, were among the first groups to recognize the need to educate citizens. At about the same time, many educational and scientific societies also recognized this need. The International Federation of Information Processing Societies' Working Group in Secondary School Education, for instance, suggested that since it is important for all students to understand the nature and use of computers in modern society, teachers of all subjects should have a knowledge of computing. The Association of Computing Machinery's Elementary and Secondary Schools Subcommittee's Working Group on Computing Competencies for Teachers recently issued a similar plea (50). On several occasions, the Conference Board of Mathematical Sciences has also recommended the development of a computer literacy curriculum for precollege students (17); and in 1978, the National Council of Supervisors of Mathematics issued a position paper which included computer literacy for all citizens in a list of 10 basic skills. Most recently, the National Council for the Social Studies, in its position statement on curriculum, suggests that students be taught data processing skills.

In what is perhaps the most complete analysis of the importance of computer literacy, Andrew Molnar concludes that there is

> ...a national need to foster computer literacy. Further, if we are to meet this need, we must ensure that high school graduates have an understanding of the uses and applications of the computer in society and its effect upon their everyday lives....A nation concerned with its social needs and economic growth cannot be indifferent to the problems of literacy. If we are to reap the benefits of science-driven industries, we must develop a computer-literate society.(37)

Definitions of Computer Literacy

Ten years ago "computer literacy" was a novel phrase, but now it is commonly used by educators, computer scientists, and journalists. Computer literacy has two major definitional roots: (1) the variety of specialized literacies, such as scientific literacy; and (2) general language literacy which encompasses reading, writing, and understanding. The conjunction of "computer" and "literacy" has had an intuitive appeal since communication with computers via computer language is analogous to interpersonal communication via ordinary language.

There are two generally accepted dictionary definitions of language literacy. One is the ability to communicate (for example, reading and writing); the other is the state of being informed, "cultured," and well versed. Although these definitions may be partially contradictory, the public continues to use the word literacy in these two ways. The descriptor "literate" is generally used to suggest a threshold on the literacy continuum. For instance, we might speak of a literate society as one where almost everyone can read and write. Or we might refer to a learned, knowledgeable, well-read person as literate. This discrepancy arises from "literate" meaning at times a "minimal" literacy level and at others meaning a very high literacy level.

The tradition of scientific literacy, and related forms such as technological literacy, economic literacy, and geographic literacy, to name only a few, suggests that the term literacy is mostly a matter of being informed rather than a communication skill. Both scientific literacy (44) and technological literacy have generally been defined as scientific and technical knowledge pertaining to social implications. Thus, for example, scientific literacy does not refer just to one's knowledge of biology, or more generally, the science-society interface. It is no wonder that in the computer literature the term computer literacy is equated with "computers and society."

We have proposed a definition of computer literacy which incorporates knowledge of computers, social implications of that knowledge, and also recognizes the need for skills in communicating with computers (3). Computer literacy, in our definition, is "whatever understanding, skills, and attitudes one needs to function effectively within a given social role that directly or indirectly involves computers." It should be clarified that we interpret "function effectively" within roles to be a matter of well-being and personal comfort, not just rational goal attainment. For the purpose of this article we apply the term "computer literacy" to the two most general roles--citizen, and, by implication, student.

and these are summarized as follows:

1. APPLICATIONS. This area covers the multitude of social and organizational areas into which computers have been integrated. It also covers the general considerations for applying computers to new situations.

2. HARDWARE. This domain deals with the basic vocabulary of computer system components. Just how extensive this knowledge should be depends upon the social role of the learner.

3. IMPACT. This domain encompasses the social effects of computerization, including both the positive and negative impacts of computers on society.

4. LIMITATIONS. This domain is distinguished from the applications domain because of the focus on developing a general sense of the capabilities and limitations of computing machines. Examples of computer limitations include the facts that computers do not have feelings and consciousness, nor are they able to make value judgments.

5. PROGRAMMING/ALGORITHMS. This domain deals with the ability to read, modify, and construct algorithms and programs.

6. SOFTWARE AND DATA PROCESSING. This area includes vocabulary relevant to software, information processing, and data.

7. USAGE. While the foregoing areas are largely cognitive in emphasis, this domain involves motor skills for sequencing and execution of certain tasks on the computer or computer terminal.

8. VALUES AND FEELINGS. The effective domain centers on developing positive attitudes toward personal use of computers as well as balanced attitudes toward computers as a social force.

For the cognitive objectives, the first digit after the letter refers to a cognitive level--1 indicates a low level, generally a skill or knowledge of facts; 2 indicates a higher level of understanding, requiring some analysis and/or synthesis. The final digit is merely a count of items within each level, in some sort of logical sequence. For the psychomotor and affective objectives, the first digit is merely for recording purposes--no attempt was made to suggest any priorities.

The detailed objectives within each of the eight categories follow.

Applications (A)

A.1.1. Recognize that computers and computer-supported applications are used in a wide variety of ways to assist individuals, groups, and institutions.

A.1.2. Recognize specific uses of computers or computer-supported applications in many of the following areas:

a. medicine and health care
b. law enforcement and criminal justice
c. education and training
d. engineering and design
e. business and banking
f. the office
g. transportation and traffic control
h. defense systems
i. weather prediction
j. recreation
k. government and politics
l. the home
m. the library
n. manufacturing
o. the creative arts
p. publishing
q. public utilities--telephone and power plants.

A.1.3. Recognize that the following are common types of computer applications, and be able to give an example of each type:

a. information storage and retrieval--record-keeping, data bases, etc.
b. simulation and modeling
c. process/machine control--robotics
d. computation (numerical/statistical analysis of data)
e. data processing
f. word processing
g. graphics
h. speech synthesis
i. artificial intelligence.

A.1.4. Recognize the definition of and some advantages of computer simulation.

A.1.5. Recognize that computers are generally useful for information-processing tasks which require any of the following:

a. handling large amounts of information
b. rapid handling of information
c. accuracy
d. repetition
e. storage of information in an accessible form.

A.1.6. Recognize that some of the more important factors which limit and/or restrict computer use include:

a. cost (hardware, software, maintenance, conversion, etc.)
b. people's attitudes (fears, anxieties)
c. unavailability of suitable software/applications
d. hardware limitations--storage limitations, lack of peripherals, etc.
e. complexity of some computer-supported applications.

A.1.7. Recognize that innovations in computer hardware and software continually expand the potential utility of the computer.

A.1.8. Identify some of the features of a computer-supported application which make it easy to use.

A.1.9. Recognize some advantages of using a computer for storage and retrieval of information (including continual updating and quick recall).

A.1.10. Recognize features and capabilities of personal microcomputer systems as compared to features and capabilities of large data process systems.

A.2.1. Determine how computers and computer-supported applications can assist an individual as he/she plays various roles, i.e., consumer, worker, citizen; how such systems assist groups and organizations as they attempt to accomplish tasks and responsibilities.

A.2.2. Assess the feasibility, potential benefits, and hazards of a computer-supported application (cross-reference in impact).

A.2.3. Design and develop a computer-supported application that would be personally useful.

A.2.4. Recognize some general criteria for computer usage for a particular task (e.g., purpose, time and resource constraints, ethical or moral considerations, relevance).

Hardware (H)

H.1.1. Recognize that computer hardware refers to the physical components of computer systems.

H.1.2. Recognize that chips are small pieces of silicon that contain electronic logic networks called circuits, and that a computer can be made up of chips mounted on boards.

H.1.3. Identify at least five major functions of a general purpose computer system, namely input, output, storage or memory, control, arithmetic, and timing or clocking.

H.1.4. Recognize that CPU stands for Central Processing Unit, which is the part of the computer which carries out the essential and controlling tasks. The arithmetic, control, and memory units of a computer are generally regarded as comprising the CPU.

H.1.5. Recognize that the term "mainframe" refers to the CPU and its enclosure or to large computers.

H.1.6. Recognize that a microprocessor is a single chip containing all the electronic logic of a CPU.

H.1.7. Recognize that a microcomputer is a very small computer that uses a microprocessor for its Central Processing Unit.

H.1.8. Recognize that minicomputers are a range of computers larger than microcomputers and smaller than what is usually called "mainframes."

H.1.9. Identify the meaning of acronyms including ROM, RAM, PROM, EPROM, which identify different types of memory.

H.1.10. Recognize the characteristics of secondary storage systems including magnetic tapes, floppy disks, etc.

H.1.11. Recognize that keyboards, punchcards, tapes serve as input devices.

H.1.12. Recognize that display screens, printers, punchcards, tapes serve as output devices.

H.1.13. Recognize the function of some basic communications technology, e.g., networks, distributed networks, modem or acoustic-coupler.

H.1.14. Distinguish parallel and serial communications.

H.1.15. Recognize the rapid growth of computer hardware since the 1940s.

H.1.16. Recognize the distinctions among the following terms: bit, byte, register, and word.

H.1.17. Recognize both the loose and the precise definition of "K."

H.1.18. Distinguish and be able to identify special purpose from general purpose computers.

H.1.19. Identify similarities and differences between programmable calculators and computers.

H.1.20. Distinguish analog and digital computing operations.

Impact (I)

I.1.1. Describe some of the more common computer-related careers such as computer programmer, systems analyst, computer scientist, computer operator, key operator.

I.1.2. Recognize that computers and computer-supported applications have a major impact on the way ordinary citizens live, work, and play.

I.1.3. Recognize that for at least the short-term future, computers will continue to be made smaller while the amount of information they can hold will continue to increase.

I.1.4. Recognize that computers are used to commit a variety of serious crimes, especially stealing money and stealing information.

I.1.5. Recognize that identification codes (numbers) and passwords are a primary means for restricting use of computer systems, of computer programs, and of data files.

I.1.6. Recognize that procedures for detecting computer-based crimes are limited.

I.1.7. Identify some advantages or disadvantages of a data base containing personal information on a large number of people (the list might include value for research and potential for privacy invasion).

I.1.8. Recognize several regulatory procedures (e.g., privilege to review one's own file and restrictions on use of universal personal identifiers) which help ensure the integrity of personal data files.

I.1.9. Recognize that "privacy problems" are characteristic of large information files whether or not they are computerized.

I.1.10. Recognize that computerization both increases and decreases employment.

I.1.11. Recognize that computerization can personalize and impersonalize procedures in fields such as education.

I.1.12. Recognize that computerization can lead to both greater independence and dependence upon one's tools.

I.1.13. Recognize that alleged "computer mistakes" are usually mistakes made by people.

I.2.1. Plan a strategy for tracing and correcting a computer-related error such as a billing error.

I.2.2. Explain how computers make keeping track of people more feasible.

I.2.3. Recognize that even though a person does not go near a computer, he or she is affected indirectly because the society is influenced by computerization.

I.2.4. Explain how computers can be used to impact the distribution and use of economic, social, and political power.

I.2.5. Identify and evaluate the positive and negative consequences of computer use in specific situations.

Limitations (L)

L.1.1. Recognize that computers are machines designed, built, and operated by humans to assist in many tasks.

L.1.2. Recognize that computers cannot make value judgments.

L.1.3. Recognize that computers cannot provide answers to every question.

L.1.4. Recognize that despite "artificial intelligence," computers cannot think in the way that the word "think" is normally used.

L.1.5. Identify a number of things that computers cannot do or cannot perform efficiently.

L.2.1. Distinguish major differences between capabilities and computer capabilities.

Programming/Algorithms (P)

P.1.1. Recognize the definition of algorithm and that flowcharts and programs are alternative forms for expressing algorithms.

P.1.2. Follow and give the correct output for simple algorithms expressed in words, flowcharts, or structure diagrams. The algorithms would include some or all of the following: replacment; calculation; selection (decision points); repetition (simple looping with iteration/recursion); input and output operations.

P.1.3. Given a simple algorithm, explain what it accomplishes, i.e., be able to interpret and to generalize. As in P.1.2. the algorithm could include replacement, calculation, selection, repetition, and input/output.

P.1.4. For simple programs written in a language such as BASIC or PASCAL, follow and give the correct output for the program. The programs would contain input/output, replacement, calculation, selection, and repetition.

P.2.1. Modify a simple algorithm or program to accomplish a new, but related, task. This would include changing one or two statements to solve a similar problem, and adding more statements to accommodate additional requirements.

P.2.2. Detect syntax and logic errors in an improperly functioning algorithm or program.

P.2.3. Correct syntax and logic errors in an improperly functioning algorithm or program.

P.2.4. Develop, with appropriate documentation, an algorithm or program for solving a specific problem.

P.2.5. Select an appropriate algorithm from a set of alternatives using criteria such as efficiency, elegance, and appropriateness.

Software and Data Processing (S)

S.1.1. Identify that software refers to computer programs and includes operating systems, compilers, and user (application) programs.

S 1.2. Recognize that digital computers operate upon information which has been encoded in binary, the coding system which can utilize the base 2 number system.

S.1.3. Recognize that a computer needs instructions to operate.

S.1.4. Recognize that a computer gets instructions from a program written in a programming language by a person.

S.1.5. Recognize that computer programs are sets of sequential instructions which perform many tasks such as printing, sorting, calculating.

S.1.6. Identify that the basic elements of an information processing system are input, processing, and output, in that order.

S.1.7. Identify the fact that data are symbols representing things.

S.1.8. Identify the fact that information is data which have been given meaning.

S.1.9. Identify the fact that communication is the transmission of information via coded messages.

S.1.10. Identify the need for data to be organized in order to be useful.

S.1.11. Identify the fact that data processing involves the transformation of data by means of a set of predefined rules.

S.1.12. Recognize that computers process data by searching, sorting, deleting, updating, summarizing, moving.

S.1.13. Recognize that software refers to any nonpermanent sets of programs, whereas firmware refers to software that has been made physically permanent.

S.1.14. Recognize that an operating system is software or firmware that performs file managing tasks such as loading programs, copying files.

S.2.1. Select an appropriate attribute for ordering of data for a particular task.

S.2.2. Design an elementary data structure for a given application (that is, provide order for the data).

S.2.3. Design an elementary coding system for a given application.

Usage (U)

U.1.1. Connect a microcomputer or computer terminal to a power source and available storage units such as disks or tapes.

U.1.2. Interact with a computer in an online instructional learning situation involving drill and dialogues.

U.1.3. Use system commands for an available computer system (e.g., command to load, list, execute, save, and purge files).

U.1.4. Use program documentation to select and run library programs for specific tasks.

U.1.5. Enter, compile, and debug a simple stored program written in a "higher-level" language.

Values (V)

V.1.1. Does not feel fear, anxiety, or intimidation from computer experiences.

V.1.2. Feels confident about his/her ability to use and control computers.

V.1.3. Enjoys and desires work or play with computers, especially computer-assisted learning.

V.1.4. Describes past experiences with computers with positive-affect words like fun, exciting, challenging.

V.1.5. Given an opportunity, spends free time using a computer.

V.1.6. Values the potential role of computers in meeting societal and institutional needs (e.g., making full, accurate information available for relevant decisions, problem solutions, or inquiries by private individuals; handling routine data collection/processing/monitoring tasks efficiently).

V.1.7. Values efficient information processing provided that it does not neglect accuracy, the protection of individual rights, and social needs.

V.1.8. Values computerization of routine tasks so long as it frees people to engage in other activities and is not done as an end in itself.

V.1.9. Values increased communication and availability of information made possible through computer use provided that it does not violate personal rights to privacy and accuracy of personal data.

These objectives have been used as the basis for the development of an assessment instrument designed to measure computer awareness, knowledge, and attitudes among secondary school students. In addition, they have provided a foundation for the development of instructional materials designed to foster computer literacy. Information concerning both these projects is available from the Minnesota Educational Computing Consortium, 2520 Broadway Drive, St. Paul, MN 55113.

Conclusion

The growing reliance of our society upon computer systems demands that the public come to understand this phenomenon. Our schools are charged with the responsibility to develop instructional programs in computer literacy, which is generally understood to refer to the level of knowledge and skill a person needs to function effectively in a computerized society. Although not everyone agrees on what that knowledge consists of, it is possible to define the major components or dimensions of computer literacy. We have attempted to provide information concerning computer literacy which will be helpful to educators preparing or complementing instruction designed to promote computer awareness and understanding. In keeping with this objective, we conclude with a rather extensive list of references.

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COMPUTER LITERACY: IT'S MORE THAN JUST COMPUTER PROGRAMMING

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> If airlines had progressed as rapidly in development as computers, the Concord would be carrying 500,000 passengers at 20,000,000 mph for less than 1¢ per person to London.
>
> If the progress of manned flight had increased at the rate of computer technology, an astronaut could have orbited the earth nine years after the Kitty Hawk flight. (14, p.220)

Introduction

Computers are electronic devices that accept, process, and store data as discrete symbols. The key word in this machine's name is compute. Its ancestors are pebbles and tally sticks used to keep count of quantities. The 12th century abacus, person managed and performed, is another relative. Today's computer is highly complicated but manageable by most people if they know more about it than just punching a certain sequence of buttons. The need for knowledge about the computer has been likened to that of the telephone or car. Granted some can get along very nicely just knowing what buttons to punch or wheels to turn, but the range of possibilities of use for computers compared to that of the telephone and car seems to render the argument rather questionable.

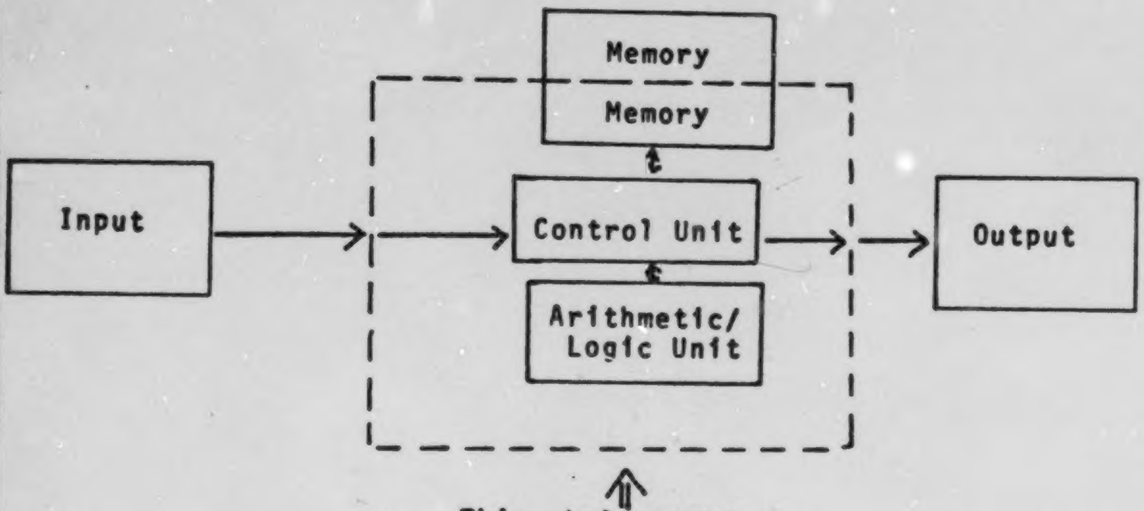
What is Computer Literacy?

There are as many definitions of Computer Literacy as there are books and magazine articles about it. It is generally understood to be that level of understanding a person needs to function effectively in a computerized society. This area of study should deal with what a computer can't do, e.g., express feelings, as well as what it can do, e.g., hold a conversation with you (the ELIZA-type program). Of course the computer isn't really conversing with you. It is just following the instructions previously given it by a human being.

Knowing all one can about computers isn't meaningless in our society as we try to project future contact with them. They are affecting our daily lives everywhere we turn even now. In the January/February 1978 issue of Creative Computing, there is an interesting article, "Five Who Most Disturbed the Thought of Man." The first was Copernicus with his nonearth centered universe, the second Darwin with man as not a special creation. The third was Freud with no rational self-determination, the fourth Einstein with a weakening of man's confidence in his observations of the physical world. Lastly is the computer with man as not unique as an intelligent manipulator of the environment and solver of problems. (1,p.34)

The four main areas discussed in this paper are hardware, programming and algorithms, applications, and social impact.

THE FIVE MAIN PARTS OF THE COMPUTER


Memory
Memory
Input
Control Unit
Output
Arithmetic/
Logic Unit

This whole section
is the Central
Processing Unit (CPU).

Note: Some Memory is part of the Central Processing Unit, and some is external to that part of the Computer.

Hardware

The five main parts of the computer are input, memory, the arithmetic/logic unit with accumulator, the control unit, and output. The middle three are the CPU, the Central Processing Unit. Jargon and buzz words abound here. One needs to know only the general concepts and not all the electrical intricacies so that when "computer people" talk or when one reads an article about computers elsewhere the "lay person" won't feel he has invaded some secret ritual for some mystical cult. They are just talking about pieces of equipment and their characteristics among themselves and to the outside world.

The three main drives for computer evolution are the need for automated arithmetic (Pascal, Leibnitz; 1600's), the need for a programmed device (Babbage; 1800's), and the need for stored instructions (von Neuman, Mauchly, Eckert; mid 1940's). This last drive set the stage for the four generations of computers: vacuum tubes (1946), transistors (1959), integrated circuits (1965), and integrated circuit chips (1970's). Integrated circuit chips made the TRS80, Pet and Apple microcomputers possible in 1977.

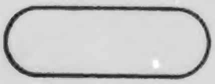
Besides the general purpose computer, mention should be made of special purpose computers, e.g., digital wristwatch, electronic car ignition. The peripherals to the computer come next: card reader, keypunch, line printer, terminals, disk drives, modems; with the accompanying I/O (input/output) media: punch cards, magnetic cards, magnetic tape, magnetic disks, and microfilm.

Programming and Algorithms

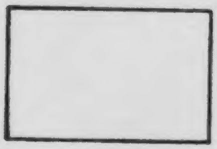
Programming is the process of writing the instructions in correct order to prepare the computer to perform a certain set of tasks. The language used can be very close to the instructions the machine actually uses, the machine language, or a set of abbreviations with commands and arguments, the assembler language, or a rather human-like language that is problem-orientated, the high level language. There are many high level languages starting with FORTRAN (FORmula TRANslation) in 1957 to BASIC (Beginners All-purpose Symbolic Instruction Code) in 1959, COBOL (COmmon Business Oriented Language) in 1959, Pascal (named after Blaise Pascal), RPG (Report Program Generator), and ALGOL (ALGOrithmic Language). All have the general concepts of

read
print
store
bring from memory storage
add
subtract
multiply
divide
stop.

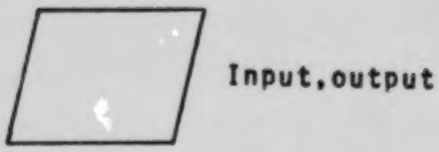
Before anyone starts writing the instructions in code form, one should establish a flow for the instructions usually in a compressed diagram called a flow chart. The five basic symbols are

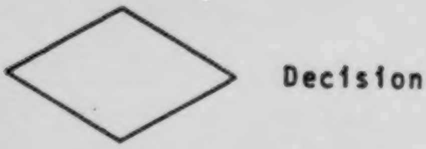


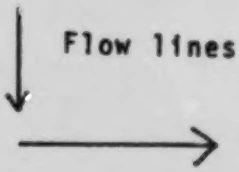
Start,Stop



Process







Certain tasks are used over and over again. The instructions are defined mathematics or logic procedures to solve a problem in a finite number of steps. These instructions become algorithms unambiguous, precisely defined, and effective.

Depending how close to machine language is the language one chooses to use will affect how fast the computer can start executing or performing the task assigned. Depending on the task to be done, certain languages lend themselves to one or other type of task by their very name.

Applications

Everywhere one looks today there seems to be a new use for a computer. If not, then someone is working on one. In the health care area, besides the administrative uses for billing, insurance, room assignment, and diets or prescriptions, medical histories, on-line monitoring, and increased diagnosis, e.g., blood tests, are taken and performed and recorded. Medical schools are running more simulations for their students, programs which can lead to the death of the case history "patient". Recertification of current physicians is starting to be performed with the use of microcomputers.

There are the standard business and financial applications of payroll, accounting, billing, word processing, and banking; but they are no longer restricted to large companies that can buy a computer of their own or can buy large amounts of computer time and memory space from service bureaus. When the Electronic Funds Transfer System (EFTS) becomes a reality, there will be no more floating of checks; for each transaction will be complete and immediate. But equipment failure here could mean a "credit blackout". No computer means no transactions!! Stores are maintaining inventory control with point of sale marketing using the Universal Product Code. Banking has an equivalent coding system, the Magnetic Ink Character Recognition (MICR). Next time the pack of cancelled checks arrives home, look at the bottom of one of them. The left side contains the checking account number and the bank number. The middle contains the individual check number. The right side now contains the amount of this check. Look at an unused check and compare them. There is no printing on the right side of the bottom of the unused check. Someone in the bank used a machine to imprint those characters onto those checks.

Science has its mathematical analysis, statistical analysis, simulation, and real time experiments. A specialized area of science, space science, has tracking space vehicles, mission control, navigation, missle guidance, monitoring of astronauts as well as its own simulations. In April 1970 a computer aided in guiding a crippled Apollo 13 spacecraft back to Earth from the moon. This April the Challenger spacecraft designed with a computer was guided and monitored by another one.

The Federal Bureau of Investigation (FBI) established the National Crime Information Center (NCIC) in the 1960's to coordinate information pertinent to its line of work. The legal profession has legal information retrieval systems, and the courts maintain records and select juries by computer.

In this age of computer graphics, computer usage in industry has especially come to the fore. There is also the analysis of writing style, detecting the influence of one poet on the works of another, choreographing a ballet, and composing a symphony.

There are the applications of the quite visible home computers. Some computers are not so obvious; they are the embedded computers. Microwave ovens, blenders, automobiles, televisions, stereo turntables, cameras, and telephones can be guided and controlled by computers. Computers will help handicapped people move, talk, and even live.

Social Impact

Society today and tomorrow will have need of the computer's information. A microbe on earth 3 billion years ago contained 1 million bits of information in it, roughly 1 book say. The human being today in his genes contains 3,000 books of information and 3,000,000 books of information in his brain. Somewhere else all this additional information must be stored and be ready for use when necessary. For all its trouble, computerized information is harder to be copied, altered, or destroyed by the routine user: the secretary misfiling a folder, the custodian incinerating valuable papers. Malicious actions (theft, fraud, forgery, trespassing, or wrongful interference) can be minimized by "keys" or identification cards, passwords, or voice/finger/handprinting. Another danger is misuse of data or false data on which one cannot check. The Privacy Act of 1974 allows any American citizen the right to investigate the federal files on himself to verify the information, include a letter noting discrepancies to be included in that file. Only catch is that one must apply to each data base individually in writing, roughly 1800 groups of data files maintained by 82 federal agencies.

Artificial Intelligence (AI) is the branch of computer science that studies how to make computers smarter. Natural-language understanding, speech and pattern recognition, image analysis, and information retrieval are areas of application of AI. Can this mean a take over by the computer? Could there be a real HAL as in 2001: A Space Odyssey or a real PROTEUS from Demon Seed or even COLLOSSUS in the story of the same name by D.F. Jones? One might say that's science fiction. Remember that the science fiction of 20 or 30 years ago are the computer applications of today.

This priesthood of "computer people" has established a need for a new classification for people: technocrats and computer peasants. There are extremists also. The people that practically eat, breathe, and sleep computers could be considered cyberphils. The other extreme group of people are those who don't want to even admit the existence of computers let alone touch them are the cyberphobs, suffering from technology shock. They feel dehumanized where the person appears to be the slave to the technology and may even feel aggressive to the computer.

For the jobs lost by the introduction of the computer into a company, the employee can be retrained and could let the computer help match job opportunities to his abilities. New jobs are being established. People are needed to design, build and maintain this equipment. People are needed to write the required programs and to input the necessary data. A whole field of human factors engineering or ergonomics has blossomed trying to make the computers, the lights, furniture, and terminal keyboards "user-friendly".

Affective Domain

In the last 9 pages, the major emphasis was on the six areas of the Cognitive Domain of Benjamin Bloom: knowledge, comprehension, application, analysis, synthesis, and evaluation. These constitute what can be considered a regular approach to a body of knowledge.

The uses and roles of the computer in people's lives are so highly charged with emotion that a concerted effort must be made in the five major areas of the Affective Domain: receiving, responding, valuing, organization, and characterization by a value system.

These areas must be taken into account and worked on by even instructors of business data processing and computer science. Students should learn to help other people cope with computers since these students are to be considered in the group "computer people". Ethical standards should be nurtured. Only with viligance will the abuses of computer power ever be stopped before starting. Tolerance of non "computer people" is to be encouraged. Legal responsibilities of computer use should be explained and discussed with the student establishing a judgment system to govern his conduct in using the computer.

MECC Report

The State of Minnedota has established a public organization called the Minnesota Educational Computing Consortium (MECC) in 1973 to assist Minnesota colleges and schools implementing educational computing. MECC has provided low-cost time-sharing computer systems and microcomputer purchase contracts at group rates, development of educational courseware, and inservice training of educators.

In 1979, the Minnesota Computer Literacy and Awareness Assessment instrument was designed for the assessment of secondary school students. In the Cognitive Domain, questions were developed to test the Computer Literacy areas of hardware, programming and algorithms, software and data processing, applications, and impact. Questions testing attitudes, values, and motivation constituted the Affective Domain.

The MECC study questions are interesting to answer to find one's own approach to computers. A set of similar questions at the beginning of a Computer Literacy course and repeated at the end with a comparison between the two sets of responses would be enlightening. Some sample questions are:

8. Walking through a room filled with computers would make me feel uneasy.

15. Computers are gaining too much control over my life.

19. Computers can be useful in learning many subjects besides mathematics.

32. Most nurses give injections by computer.

42. Some computers know just about everything.

(2, Appendix F)

This study isn't meant to be the answer though. There are objectors, Arthur Luehrmann for example, who state that Computer Literacy is the ability to do computing so that there is just a need for performance objectives. The report gives the state of computer education in Minnesota during 1978-1979. It deals with Computer Literacy with respect to informational objectives, above broad learning goals but short of specific behavioral objectives.

Computer Literacy is not Computer Science. Hands-on experience doesn't necessarily lead to Computer Literate people.

Other projects primarily Computer Assisted Instruction involved the development of new equipment. One predates the establishment of MECC. In 1960 Donald Bitzer at the University of Illinois designed a new system called PLATO (Programmed Logic for Automated Teaching Operations). It didn't start out as a Computer Literacy project. Yet today a version of PLATO scaled down to fit an Apple II Plus microcomputer is teaching Computer Literacy. Kenneth Stetten at MITRE Corporation together with Brigham Young University developed TICCIT (Time-shared Interactive Computer Controlled Informational Television). Educators involved with Computer Literacy can and should use these and whatever new equipment that comes into being to reach the most people.

Position Statements

Following are two position statements the first from the Board of Directors of the National Council of Teachers of Mathematics in September 1976 and the second from the National Council of Supervisors of Mathematics in 1978. They seem to summarize nicely the current situation.

> Although computers have become an essential tool of our society, their diverse and sustained effects on all of us are frequently overlooked. The astounding computational power of the computer has altered priorities in the mathematics curriculum with respect to both content and instructional practices. Improvements in computer technology continue to make computers, minicomputers, and programmable calculators increasingly accessible to greater numbers of students at reasonable cost.
>
> An essential outcome of contemporary education is computer literacy. Every student should have firsthand experiences with both the capabilities and the limitations of computers through contemporary applications. Although the study of computers is intrinsically valuable, educators

> should also develop an awareness of the advantages of computers both in interdisciplinary problem solving and as an instructional aid. Educational decision makers, including classroom teachers, should seek to make computers readily available as an integral part of the educational program.
>
> (12, p.468)

> It is important for all citizens to understand what computers can and cannot do. Students should be aware of the many uses of computers in society, such as their use in teaching/learning, financial transactions, and information storage and retrieval. The "mystique" surrounding computers is disturbing and can put persons with no understanding of computers at a disadvantage.
>
> (11, p.150)

These two statements summarize educators' recognition of the need for Computer Literacy even though they are both from Mathematics educators. With the proliferation of microcomputers it is now possible for small school systems and individuals to buy a starter microcomputer for less than $100. Computer Literacy is just a start into the future.

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HARDWARE SELECTION AND EVALUATION

By Gary G. Bitter

Picture yourself in a candy store standing in front of long glass cases displaying jars of rainbow-colored gumdrops, tins of imported chocolates, strings of licorice, and dozens of other confectionary delicacies. You have a quarter to spend, and it is very important to you to make the right choices and get the most you can for your 25¢. The problem is that everything you see is so enticing that you simply cannot decide what to buy.

Many people who are faced with the task of purchasing computer hardware for educational applications find themselves in exactly this position. There are myriad types and brands of computers, each with particularly attractive features of its own. To further complicate matters, there is an even wider range of peripherals (accessory equipment other than the main computer) that enhance the capabilities of today's microcomputers. Add to that the unfortunate fact that many computer salespeople are not fully informed of the capabilities of the hardware they sell--not surprising when even experts in the field of educational computing offer conflicting advice. What you have is a perplexing puzzle made up of hardware and software pieces that you must fit together into a complete and clear picture of educational computing.

But if the puzzle is perplexing, it is also intriguing in its challenge. The key to solving the puzzle lies in first determining what you expect from the microcomputer in the corner of your classroom. How will it function? How do you intend to use it? Once you answer these questions, you can begin shopping with a clear idea of what features are most important to you.

Because the selection of educational software is limited, it is ideal to consider hardware and software simultaneously. Many people have experienced the frustration of purchasing an excellent CAI software package only to discover that they do not have access to the hardware required to run the program. A firm decision about the kind of software you want to use in your classroom will help to limit your choice of microcomputer systems since many programs are designed specifically for use with particular brands of computers.

It is vitally important that you anticipate the uses your computer will serve before you begin visiting computer stores and talking with sales representatives. The number of applicatons of computers in educational settings is virtually limitless, and you will want to purchase a computer with the features required for the applications you have in mind. Some of the uses that computers serve in schools are:

--Programming instruction

--Computer literacy classes

--Testing and test banks

--Computer-aided instruction

--Computer-managed instruction

--Simulation of dangerous or difficult laboratory experiments

--Laboratory instruments that measure quantitative values

--Music composition and training

--Word processing instruction in business education classes

--Word processing in English composition classes

--Accounting instruction

--Administrative functions

--Guidance (especially accessing national data bases)

--Library procedures

--Basic electronics instruction (assembling computers from kits)

--Graphics design

--Math instruction including computer programming

--Locating research sources

--Simulations for political science, social studies, and economics classes

--Statistical interpretation of data

--Individualized G.E.D. instruction

--Student newspapers

--Worksheet and puzzle generation

--Determining readability levels of textbooks and other instructional materials

--Vocational training

Once you have determined the purposes that your computer will serve, survey the software available for these applications. Find out how software availability limits your choices of hardware. Of course, there is an alternative to purchasing prepackaged software. If you choose to develop your own educational software, you will have a wider range of hardware choices. The drawback to developing your own software is the time, money and effort that this endeavor requires.

Perhaps your school district is interested in developing software for district-wide use. Software developed within your system may be shared, traded, and sold, an advantage of software development. This also helps to standardize computer education programs within a given school district. If you decide to follow this course, you should be realistic about the process of software design. It requires a substantial amount of time and expertise. The district may need to hire outside consultants who have more computer expertise than classroom teachers can reasonably be expected to have. Classroom teachers, after all, are primarily responsible for the daily educational experiences of their students. Teachers should never be expected to develop educational software in their spare time, a rare luxury for most teachers. Instead, the school district must be willing to allocate the large amount of human and monetary resources required for software development.

Assuming that you do not choose to develop your own software and you have researched the educational software on the market to decide what sorts of programs you will be running, you are now prepared to window-shop. Visit computer retail stores in your area to see what types of hardware they offer for sale. You should also send Request for Information forms to all those manufacturers and retailers who may be considered potential bidders. You will also want to work with others in your district to develop a set of standard district-wide criteria by which to judge and compare the hardware you find on the market. Your criteria should cover a spectrum of important factors:

1. How much money has your district allotted for the purchase of computer hardware? There is a sizeable range of prices of computers, and you may find that a high-price computer is justified by the applications for which it can be used.

2. Who will use the computer? Various users require different design, safety and durability features. For example, any computer intended for use by elementary-school children must be especially "user-friendly."

3. Can the system you are considering be expanded later? If you decide to run a program that requires a great deal of memory, can you purchase additional memory for your computer?

4. How difficult will this system be to maintain? Is maintenance service quickly accessible and relatively affordable? Does the manufacturer or retailer offer a service contract? Is this equipment considered reliable? What are the experiences of other systems who presently operate this equipment?

5. Will it be easy to train teachers to operate this computer system? Does the manufacturer offer to help in the training process and make ongoing support for teachers available? How sensitive is the manufacturer to the special needs of teachers?

6. What languages does this computer support? Most microcomputers run BASIC, but a computer to be used for advance programming instruction should support

additional languages such as FORTRAN and Pascal, among others.

7. What is the size of the video screen display? Word processing applications may require 64 to 80 characters-per-line screen displays, but some microcomputers offer only 24 characters-per-line displays.

8. Is this computer capable of generating graphics? If so, is it necessary that the computer generate low-resolution graphics or must it be capable of high resolution?

9. Does the computer have color capability? While color is superfluous to basic programming classes, many CAI programs are enhanced by the addition of color.

10. Will you require a printer for your applications? If so, can the computer system you are considering be connected to a compatible printer? Word processing classes and programming classes, for example, are lost without printers. Can your district afford to purchase both computer and printer?

11. Is networking available with the computer you are considering? Networking refers to connecting a number of remote microcomputers to a central microcomputer.

This also allows for the use of a central printer, which may represent a considerable savings to the district.

12. Does this computer come with clear and thorough documentation? Is the documentation well indexed for ease of use?

13. Is this computer portable? If one computer is to be moved from classroom to classroom for computer literacy instruction, portability is a crucial feature. If the computer will be permanently housed in one location, this is not so important.

14. Will this computer operate safely and efficiently in the environment in which you will house it? Do you need to purchase additional safety equipment such as antistatic mats to ensure safety and efficiency? In dry climates, for example, computers must be housed in rooms that are not carpeted or else they must be placed on antistatic mats.

15. How is the keyboard of this computer designed? Will it be comfortable for students to use? Some microcomputers have keyboards very similar to a standard typewriter while others have flat, touch-sensitive mylar surfaces. Other have calculator-style keyboards.

Does your application affect the type of keyboard you require?

16. Does this computer allow for fast and simple editing? What is its process for correcting typing errors and inserting words? Small children, for example, require one-step editing procedures. Complicated correction processes are frustrating to many students.

17. Is this computer capable of voice generation? Is this feature necessary or attractive for your applications?

18. How flexible is the computer system you are considering? If your needs change, can you use this system for applications other than those you plan to implement now?

19. Is this system compatible with other computers that your district owns? This has a number of potential advantages, making your computer more cost-effective.

20. Can this computer be interfaced with mainframe computers through telephone lines or cables? This will provide access to national data bases, which will be an important way of obtaining up-to-the-minute information in the future.

Add to this list any other features and concerns that you feel are essential to your choice of hardware. Perhaps you will want to devise a system of numerically scoring the extent to which each microcomputer you evaluate meets these criteria. This will help you make a more objective selection. Consider implementing a district-wide standardized evaluation form so that teachers can share the information they uncover while window-shopping.

Now you are ready to start off for the nearest computer store. To provide you with a fundamental basis for comparison of the hardware you will find there, the following discussion briefly describes a number of types of microcomputers that have already found their way into today's computer-aware classroom setting.

A Survey of Commonly Used Microcomputers

There is a range of microcomputers in common use in educational settings, and several new microcomputers on the market promise to become equally popular. While there is currently a shortage of outstanding educational software to be run on these computers, it is likely that computer manufacturers will concentrate their efforts toward supplying this shortage. As computers become smaller and more affordable, they will be purchased for educational purposes. When this happens, microcomputer manufactuers will respond to the needs of classroom teachers and others for a variety of high-quality educational software. In this section, we will explore some of the features of microcomputers frequently used in educational settings as well as speculating about several machines that are new to the market but promise to become quite popular.

Keep in mind as you read this discussion of popular microcomputers that the computer field changes so rapidly that you will want to consult microcomputer manufacturers themselves for up-to-the-minute information about technology. However, this discussion should provide you with some basis for making intelligent comparisons of microcomputers.

If you are new to the subject of computers, it may be well for you to review the following list of terms pertinent to describing and comparing the features of microcomputers:

Hardware: physical equipment that makes up a computer system.

Software: a set of human-written instructions that tells the computer how to perform specific tasks.

Memory: the physical part of a computer that stores data and program instructions.

RAM (Random Access Memory): computer memory that allows data and instructions to be retrieved in random fashion. The user can alter the contents of RAM at will.

K (Kilobyte): 1,024 characters of data, usually the amount of data that can be displayed at one time on a video screen.

Disk drive: a machine similar to a record player that is capable of reading information stored on a floppy disk. This machine retrieves information randomly.

Cassette recorder: a machine that is capable of reading information stored on cassette tapes. This machine retrieves information sequentially.

Monitor: the computer's video display.

Graphics: computer-generated patterns and artwork used for many Computer-Aided Instruction and other applications.

Low-resolution graphics: computer graphics similar to the effects that can be produced with a standard typewriter.

High-resolution graphics: computer graphics that are more sophisticated and higher-quality than low-resolution graphics.

Speech synthesis: computer recreation of humanlike voice patterns and articulation.

Numeric keypad: an arrangement of keys similar to a 10-key adding machine. The numerals 0-9 are represented, allowing for easy entry of numerical data.

Peripherals: computer hardware other than the central microcomputer system, such as printers, game paddles, disk drives, language cards, etc.

Interfacing: connecting peripheral equipment to the microcomputer.

The Apple is particularly well suited for educational settings because of its full color and sound capabilities that make educational software more attractive to students. With the purchase of additional hardware, the user can even enjoy speech synthesis and networking. In addition, there is a wide range of other peripheral equipment available to broaden the capabilities of Apple microcomputers. These features make the Apple computer very popular in many school settings.

Atari

Atari used to be known primarily for the wide selection of electronic games they offered on the market. With the introduction of PILOT with Turtle graphics, many schools have found that both the Atari 400 and 800 are user-friendly, an attractive feature of computers to be used with small children. Both models accept easily inserted cartridges containing software, and both can be programmed in a variety of languages.

Atari microcomputers are capable of generating sound and music. Both also have upper-case and lower-case letters. Atari offers high-resolution graphics of outstanding quality. Its screen can display 40 characters per line and 24 lines at one time. The Atari is used with either standard television sets or monitors, and it may be connected to a number of peripherals to enhance its capabilities.

The Atari 800 can be purchased with memory ranging in size from 16K to 48K. The memory of the Atari computer can be increased by the simple insertion of a cartridge containing an additional 8K or 16K of memory. Its keyboard is similar to that of a standard typewriter keyboard except that it emits a beep each time it enters a character. The Atari 800 has two slots for inserting software cartridges.

The Atari 400 features a memory that can be expanded to 16K. It is smaller and weighs less than the 800, and its keyboard is a smooth touch-sensitive mylar surface. This type of keyboard is less easily damaged than the typewriter-like style and protects the internal parts of the computer from spillage, dust and other substances that may have an injurious effect.

COMMODORE BUSINESS MACHINES

Commodore 64

Probably the most attractive feature of the Commodore 64 microcomputer is the ease with which the user can learn to operate it. It also can be operated reliably with cassette or disk storage. The user is guided through each step of the process of loading a program by clear instructions that appear on the video screen. The 64 is easily portable, which makes it a good choice for applications in which the microcomputer will be moved from classroom to classroom.

The 64 allows for simple editing of programs. Its keyboard is capable of generating both upper- and lower-case letters, and it has extensive and unique graphics capabilities. It can be used with any of several networking systems.

The Commodore 64 comes with 64K memory. There is a substantial amount of educational software available for use with the Commodore 64. It can also support programs written in LOGO and Pascal. In addition, it can be connected to a wide range of peripheral accessories. All of these features make the Commodore 64 a very popular microcomputer in educational settings.

VIC-20

The VIC is an attractive microcomputer from Commodore with a popular price. It produces upper- and lower-case letters, full-color graphics, and sound capabilities. Although it can only generate low-resolution graphics, the VIC has special graphics characters included on its keyboard. The VIC comes with a small memory of 5K, but this amount can be expanded to 32K for applications that demand more memory. The small display may prove frustrating to serious students of programming, and this is a considerable disadvantage of the VIC. Its small size and graphics capability combined with its relatively inexpensive purchase price have made the VIC a popular microcomputer for home and school settings.

The Super Pet

True to its name, the Super Pet is a superior computer for many applications. Its video screen displays 80 characters per line and 25 lines at one time. Its memory size reaches to 96K, making it very powerful for such a small machine. The programming student can easily choose from APL, BASIC, FORTRAN, Pascal and Assembler, all of which are contained within the console of the computer itself. The Super Pet is easily interfaced with mainframe computers. It arrives with clear and thorough documentation to orient the user to its capabilities.

The keyboard/processor unit and green phosphor monitor are contained within the Super Pet cabinet. It can run software that has been designed for the Pet and the CBM 8032 (a business-oriented Commodore microcomputer) without any modifications. With additional hardware offered by an independent manufacturer, the Super Pet becomes capable of generating high-resolution graphics in black and white. It is not presently capable of color, music or speech synthesis. However, it does possess some sound capability. Its large memory and language flexibility make it an excellent computer for use in advanced computer programming applications.

IBM Personal Computer

A long-time innovator in the field of computers, IBM recently introduced its first personal computer. Some experts consider this microcomputer to be exceptionally well designed. A wide range of hardware and software are available for use with this personal computer. The IBM Personal Computer can be connected to any black-and-white or color monitor or to a standard television set. Its memory size is extremely flexible; it can be expanded to 512K. The IBM Personal Computer is compatible with a variety of disk drives, printers and other peripherals.

Its video screen displays 80 characters per line and 25 lines at one time. The typewriter-style keyboard generates both upper- and lower-case letters and is even capable of underlining. The IBM Personal Computer generates colorful high-resolution graphics of outstanding quality, and sound capability is a standard feature. It supports programs written in BASIC and Pascal as well as APL. Additional hardware purchased from other manufacturers can further enhance this microcomputer's capabilities with speech synthesis and networking potential. The IBM Personal Computer comes with clear and explicit documentation.

Radio Shack Computers

With the introduction of its TRS-80 Model I in 1977, Radio Shack began to make a name for itself in the field of microcomputers. Its great success is due in part to the many Radio Shack outlets available to sell and maintain their computers. Since its introduction, the TRS-80 has been enhanced by a wide range of peripheral equipment designed by Radio Shack and other manufacturers.

Radio Shack displays interest in educational applications of microcomputers and even offers cost-free lessons in BASIC for teachers and others involved in education. Radio Shack documentation is noted for its clarity and simplicity.

TRS-80 Model III - Model IV

The TRS-80 Model III and IV are all-in-one microcomputers. Disk drives, cassette recorders and printers must be purchased separately. The keyboards are similar to that of a standard typewriter. Their video screen displays 64 characters per line and 16 lines at one time, making this model a good choice for word processing applications. In addition, it is capable of speech synthesis and networking.

Although the TRS-80 Model III and Model IV are only capable of low-resolution black and white graphics, they do include special graphics characters and a numeric keypad.

TRS-80 Color Computer

The TRS-80 Color Computer is built in a modular design with a keyboard unit that can be connected to any black-and-white or color television set. The 4K Color Computer can be expanded with the purchase of additional memory. Its video screen displays 32 characters per line and 16 lines at one time. The TRS-80 Color Computer is capable of high resolution graphics and comes with sound capability as a standard feature. It includes a calculator-style keyboard. It can be operated with either disk or cassette storage.

Currently, there is not a great deal of software available for the TRS-80 Color Computer. As this microcomputer becomes more prevalent in home and school settings, however, this is likely to change. More software will be offered in the future.

TEXAS INSTRUMENTS

TI 99/4

In 1979, Texas Instruments introduced its TI 99/4, advertised primarily as a home computer. It runs plug-in ROM cartridges that generate high-quality and vividly colored graphics. Its plug-in design makes it simple for even small children to use, lending to its popularity in home applications. It can be operated with disk or cassette storage, in addition to preprogrammed ROM cartridges. An excellent speech synthesizer can further enhance the TI 99/4.

The video screen of the TI 99/4 displays 32 characters per line and 24 lines at one time. It generates upper-case letters only. It is capable of high-resolution graphics, and its sound system is notably well-designed. It has a calculator-style keyboard that has proven nonthreatening to small children who have not yet learned to type. Its editing procedures are relatively complicated.

Unfortunately, there is a shortage of educational software that can be run on the TI 99/4. In addition to supporting TI BASIC, however, this microcomputer can also run programs in LOGO, a simple language designed especially for educational applications. This feature makes the TI 99/4 an attractive choice for educational settings where small children will be operating computers.

TI 99/4A

The TI 99/4A is a new model offered by Texas Instruments. Possessing the same capabilities as the TI 99/4, the TI 99/4A enjoys the advantage of an improved keyboard design. The keyboard/computer has memory ranges in size from 16K to 48K. Monitors and peripheral hardware must be purchased separately.

Xerox 820

The Xerox 820 was designed primarily for business office environments. Included are the computer, a twelve-inch black-and-white video screen, and two disk drives. Its video display is 80 characters per line and 24 lines at one time. While it does not possess color or sound capability, the Xerox 820 does generate low-resolution graphics. This microcomputer was designed specifically to run a large amount of CP/M software already in existence, so the user has a good selection of business and word processing software to choose from. Additional hardware from another manufacturer makes the Xerox 820 capable of networking. Its typewriter-style keyboard includes a convenient numeric keypad.

Xerox's main thrust has been the business field, and so little or no educational software exists for use with the Xerox 820. The microcomputer is still relatively new, though, and cannot be fully evaluated until it has received a considerable period of consumer use.

Summary

Today's microcomputer market offers the prospective computer user a wide range of machines with a number of attractive features. The wisest way to approach shopping for the computer that will best meet your needs is to determine exactly how your computer will be used. This will help you to decide which features are most important to you. Once you have narrowed down your list of prospects to several likely candidates, you will find it much easier to make your final choice. Keep in mind also that your choice of microcomputers should be made in conjunction with your choice of software to assure compatibility.

TABLE 1:

Major Features of the Apple IIe Microcomputer

Memory range	64K
Keyboard	standard typewriter
Type	upper-case letters (can be modified for lower-case also)
Languages	BASIC, FORTH, COBOL, PILOT, FORTRAN, LOGO, Pascal and others
Video display	40 characters-per-line 24 lines-per-screen (can be modified for larger display)
Special features	full color and sound capabilities

TABLE 2:

Major Features of the Atari 400 and Atari 800 Microcomputers

	Atari 400	Atari 800
Memory range	up to 16K	16K - 48K
Keyboard	touch-sensitive mylar surface	standard typewriter
Type	upper- and lower-case	upper- and lower-case
Languages	accepts programmed cartridges in several languages	accepts programmed cartridges in several languages
Video display	40 characters-per-line, 24 lines-per-screen	40 characters-per-line, 24 lines-per screen
Special feature	High-resolution graphics	High-resolution graphics

TABLE 5:

Major Features of the COMMODORE Super Pet Microcomputer

Memory range	up to 96K
Keyboard	standard typewriter
Type	upper- and lower-case letters
Languages	console contains APL, BASIC, FORTRAN, Pascal and Assembler
Special Feature	sound capability

TABLE 6:

Major Features of the IBM Personal Microcomputer

Memory range	64K - 512K
Keyboard	standard typewriter including foreign punctuation marks and APL symbols
Type	upper- and lower-case letters with underlining capabilities
Languages	BASIC, Pascal, APL
Special features	high-resolution color graphics; sound capability

TABLE 7:

Major Features of the TRS-80 Model III and IV Microcomputer

Memory range	16K - 32K
Keyboard	standard typewriter and numeric keypad
Type	upper- and lower-case letters
Language	BASIC
Video display	64 characters-per-line 16 lines-per-screen
Special features	speech synthesis; networking; low-resolution black-and-white graphics

TABLE 8:

Major Features of the TRS-80 Color Computer

Memory range	begins at 16K
Keyboard	calculator-style
Language	BASIC
Video display	32 characters-per-line 16 lines-per-screen
Special features	high-resolution graphics; sound capability

TABLE 9:

Major Features of the TI 99/4 and TI 99/4A Microcomputers

	TI/99/4	TI 99/4A
Memory range	uses plug-in ROM cartridges	16K - 48K
Keyboard	calculator-style	improved TI 99/4 design
Languages	TI BASIC, LOGO	TI BASIC, LOGO
Video display	32 characters-per-line, 24 lines-per-screen	32 characters-per-line, 24 lines-per-screen
Special features	full-color graphics; well-designed sound system; user-friendly	full-color graphics; well-designed sound system; user-friendly

TABLE 10:

Major Features of the Xerox 820 Microcomputer

Memory range	64K
Keyboard	standard typewriter with numeric keypad
Language	runs existent CP/M software
Video display	80 characters-per-line, 24 lines-per screen
Special feature	designed particularly for business and word processing applications

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Coburn, Peter, et al. Practical Guide to Computers in Education. Reading, Mass.: Addison-Wesley Publishing Company, 1982.

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SOFTWARE FOR YOUR COMPUTER
DESCRIPTIONS AND EVALUATIONS

By Gary G. Bitter

Although computers are very powerful machines capable of performing any number of tasks, they are virtually useless without appropriate software, the human-written set of instructions that tell a computer how to accomplish the work it is given to do. This is especially true of computers in the classroom. With the aid of intelligently written software, the computer is an extremely useful instrument of learning. Without such software, the computer cannot be used to its fullest potential. At first perusal of the vast quantity of computer software offered on the market for sale, you may think that you need a degree in computer science to make wise and cost-effective choices about what software to use with your particular microcomputer. This is not the case, however. With an understanding of a few basic concepts of software, you can purchase the software that will maximize your classroom computer experience.

First, you must determine precisely how you envision your classroom computer will perform. There are two fundamental approaches to computer education (Zalewski, et al., 1982). Some teachers prefer to have students use the computer either to program or to perform a specific function. In this case, students often design their own software during the course of the learning experience. Other teachers use computers to supplement traditional teaching methods. This system is called Computer-Aided Instruction (CAI). The teacher who uses CAI is faced with the task of choosing from among the many software products available in order to design a curriculum that meets the needs of students effectively.

To make wise choices about software purchases, you need to have a clear idea of what you wish the computer to do (Bitter, 1983). There are several types of CAI software from which to choose. The grade level and the ability level of your students will help you to determine what type of software will be most effective in teaching your students.

Drill and Practice Software

By far the most common type of CAI software available is drill and practice software. This type of program randomly generates practice exercises for students to complete. The simplest kind of drill and practice program simply displays the problems, allowing the student to enter an answer. The computer then reports whether the student's response is correct or incorrect.

More sophisticated drill and practice programs tap some of the computer's other capabilities: graphics, animation, and sound, for example. These features help to keep students' interest and encourage them to use drill and practice programs over and over. This helps to avoid one of the pitfalls of drill and practice software: some programs are boring after one use. Some drill and practice software limits the amount of time a student has to enter a response.

Drill and practice programs include some method of informing students that their responses are correct and of rewarding or positively reinforcing correct answers. They may do this by addressing the student by name (small children especially enjoy this feature), by playing cheerful tunes, or by displaying moving cartoon characters.

Not only do drill and practice programs reinforce mathematical concepts, but they can also be effective in building vocabulary in English as well as in foreign languages, teaching chemistry, enhancing music lessons, and improving a student's grasp of practically any subject taught in a traditional curriculum. The computer is particularly well-suited to this sort of task because it is infinitely patient and repetitive. It allows students to progress at their own rates of speed.

Tutorial Software

Another popular kind of CAI software is the tutorial program. This software introduces new concepts to students and may also offer drill and practice based on the concepts presented. Tutorial programs often include pre- and post-tests so that skills acquired by the students can be measured. Tutorial software is sometimes difficult and time-consuming to design and write because it must take into account various levels of student ability.

For this reason, intelligently designed tutorial programs are often hard to find. Good tutorial software is worth the effort required to locate it, though. Tutorial programs are most often used for enrichment and review of concepts that the teacher has already introduced by traditional means. It is not likely, as many people fear, that this type of computer interaction will replace the human relationship between teacher and student because the computer can make only simple logical distinctions (yes/no), and it lacks the human element that teachers provide.

Simulation Software

Perhaps the most promising field of CAI software is simulation software, which recreates a "real life" situation so that students may experience a given set of conditions. In a simulation setting, students must make choices and then deal with the consequences of those choices. This teaches the vital skill of decision-making. Often, joysticks and paddles are used to manipulate characters and figures that appear on the video screen. Situations like elections, operations of nuclear power plants, life on the frontier, and space travel can be recreated by simulation software. Besides being able to recreate conditions similar to those that occur in reality, simulation software can recreate imaginary settings that keep students interested in the material being presented.

Because it often includes graphic and audio effects, simulation software makes good use of the full capabilities of the microcomputer. For this same reason, it is difficult and time-consuming to design and write. The future offers great potential for growth in the field of simulation software. Indeed this is probably the most promising type of CAI software being developed.

Computer-Managed Instruction Software

To make the most of the computer in your classroom, you may choose to use if for purposes other than teaching.

There is a good deal of software available that enables your microcomputer to relieve you of a number of the routine and laborious record-keeping tasks that face you daily. You will want to survey this software, which is categorized as Computer-Managed Instruction (CMI) software.

You will find CMI software helpful to you in measuring your students' skills. When appropriate, CMI programs direct students to other parts of CAI programs or to other programs entirely. Or CMI programs may suggest that students confer with the teacher for additional help. In some cases, the CMI program can make assignments in related workbooks and textbooks. They can keep track of each individual student's progress as well as monitoring the progress of the class as a whole.

Unfortunately, high-quality CMI software is often difficult to obtain. The quality of such software can only be accurately determined after the software has been implemented and used for some period of time. This makes the purchase of CMI software risky. However, the time and energy saved by good CMI software more than compensate for the effort expended in acquiring it. Teachers who use CMI software are freed from routine and trivial tasks to spend more time giving individual assistance to students.

Because of its complex nature, CMI software is expensive and time-consuming to develop. It may require the joint efforts of several programmers. For these reasons, most quality CMI software is developed at large publishing houses.

Administrative Applications

Appropriately chosen software makes your microcomputer an extremely versatile tool in the classroom. Aside from helping you teach and monitoring the progress of your students, your microcomputer can also relieve you of some of the administrative tasks that you and other school personnel must perform routinely. One such task is record-keeping, a chore that seems to become more time-consuming each year.

You should consider purchasing software that will help you keep track of grades. The microcomputer can be used to record grades and to store grades in a nontraditional "gradebook." The computer is capable of realphabetizing your students' grades whenever the need arises. It can also average an individual student's grades or the grades of an entire class with amazing speed and accuracy.

Still another application of this type of software is in helping teachers compose mandatory IEPs (Individualized Educational Programs). The microcomputer can simplify this task by administering tests, scoring these tests, storing results and generating reports that can be used as an accurate basis for writing IEPs.

You may also purchase microcomputer software that will help you create tests or practice exercises without requiring that you have an extensive knowledge of programming languages. In addition, you can use your microcomputer to keep detailed records of attendance, account for lunch money, maintain a current inventory list, keep track of supply requisitions, monitor field trip expenses, and aid in organizing P.T.A. activities. Indeed, the number of potential applications of such software is limitless.

The safest way to assure that you choose the best CMI software available is to compare a number of programs. You can do this talking with a variety of sales representatives. Also, contact other schools that are currently using this kind of software. Find out what programs they use and ask what problems they have with their systems. You can gain a great deal of insight from their experiences.

Special Programming Languages

Another issue to consider before beginning to purchase software is what computer language you will be using. In addition to the numerous professional computer programming languages, there are several languages that have been designed especially for use in an educational setting. Among these are LOGO and PILOT.

LOGO is a relatively simple programming language that can be used by very young children. It was designed and developed by Seymour Papert in the Artificial Intelligence laboratories at the Massachusetts Institute of Technology. LOGO has been used successfully with children as young as three years of age. Although it is simple in nature, LOGO can be used to create programs that are relatively powerful. LOGO allows even the youngest student quick and painless access to the microcomputer.

Based on common language, LOGO commands direct figures on a video screen to move about, change colors, and create pictures. Some LOGO machines are actually small robotlike mechanisms that move about on a sheet of paper, drawing lines with a pen. Children must direct the movements of the machine or of the image on the screen to create desired patterns. While commanding the LOGO "turtle" to move in various directions, students learn mathematical and geometrical concepts upon which to base more sophisticated knowledge later.

Another computer language that is well-suited for classroom use is PILOT. Radio Shack, Atari and Apple all offer their own versions of this language. PILOT is especially effective in creating interaction-style programs that are very popular with students. While LOGO is more appropriate for use with elementary students, PILOT is taught primarily to students of intermediate and senior high grade levels.

Searching Out Educational Software

As you begin your search for high-quality and powerful educational software, you have a number of resources available to you. If you consider yourself a novice, you may prefer to begin by surveying the popular computer periodicals available in libraries and computer retail stores. You might even consider suggesting that your school library purchase subscriptions to these magazines so that they will be available to students as well as to teachers.

Following is a list of periodicals to review:

AEDS Monitor

Apple Orchard

Classroom Computer News

Compute

Computers in Math and Science Education (mostly geared to high school and college)

The Computing Teacher

Creative Computing (The articles are sometimes too difficult for the beginner but it is a good source for hardware and software ads and for current information.)

C.U.E. Newsletter

Educational Computer

The Electronic Classroom

Electronic Education

Electronic Learning

Infoworld

Nibble

Personal Computing

Popular Computing (originally On Computing)

Teaching and Computers

Turtle News

If you have some amount of experience with computers, you may choose to read several of the more sophisticated professional journals devoted to computer science as well as magazines that are limited to coverage of specific brands of computers. This will provide a sound basis for comparing software and hardware. Take advantage of courses or in-service workshops that your school district offers for teachers working with computers.

You will also want to seek out opportunities for hands-on experience with computers. Several sources of such activities may be computer stores, classes offered at local universities, community colleges and technical schools, and private tutoring offered by computer specialists. You may also find that you have access to microcomputers owned by your school district. Many special programs are offered by microcomputer laboratories, microcomputer conferences, and microcomputer seminars. Finally, some computer retail stores offer small, informal classes in computer programming, and you may find these useful.

Visits to computer stores are likely to turn up all sorts of information useful in choosing and purchasing software. Design an evaluation form so that you can swiftly and easily compare the different hardware and software that you find in computer stores. Check to see whether your school district has a standard software evaluation form. Perhaps there is already a file of forms completed by other teachers in the process of designing their computer curricula.

Talk with other computer experts whenever you have the opportunity. Those involved in computer education will be particularly helpful to you since they are aware of current trends in educational software. Don't overlook parents and students who are knowledgeable about computers. They can be an invaluable source of information.

Whenever possible, try to participate in, or at least attend, decision-making meetings that will have impact on your classroom computer experience. Explore the possibility of applying for state or federal grants to help purchase hardware and software for your classroom. Many such grants are currently available.

As you shop for educational software, remember that many computer programs are designed to be run on a specific brand of computer system. In other words, hardware and software cannot be considered separately. Ideally, you should determine what sort of software you wish to run before you purchase your microcomputer so that you will be assured that your software will be compatible with your hardware.

Evaluating Educational Software

As you begin to acquire knowledge of the types of software available for the applications you have planned, you must develop some criteria by which to evaluate the quality of various programs. Try to answer the following questions when reviewing software.

--Is this software suitable for the grade and ability levels of my students? Will it be too challenging and frustrating? Will it be too simple and boring?

--Does this program require hardware that I do not have access to? (E.g., greater memory capacity, disk drives, language card, joysticks, paddles, printer?)

--Will drill and practice programs be used repeatedly? Is this program sufficiently interesting that my students will want to return to it again and again? Are math problems generated randomly? Can I revise the program easily?

--Does this program allow for typing errors that my students may make? If so, how? Is correction fast and simple?

--Can my students control the speed at which material is presented? Is the program sufficiently flexible to allow for different levels of abilities?

--If my student accidentally presses the ESCAPE key or the RETURN key, does the program end abruptly or does it offer the student a chance to correct this error?

--Does the program address my students by name?

--Does this program offer my students positive reinforcement? Is the positive reinforcement more appealing than the negative reinforcement? Nothing is more disheartening than to discover that your students intentionally respond incorrectly in order to observe the negative reinforcement because it is more entertaining than the positive reinforcement!

--Is the negative reinforcement too critical? Will it discourage students who have difficulty answering correctly?

--Would a workbook or textbook present this material just as well or more effectively than the computer does? If so, implementing this program will be a waste of valuable computer time.

--Is the text that appears on the video screen legible and attractive? Will students have to strain to read it?

--Are graphics used effectively in this program? Will the graphics or animation keep students interested in using the program again and again, thereby reinforcing the skills the program seeks to teach?

--Is this program relatively bug-free? Are there any programming errors that will make this software frustrating to my students?

--If the software (or "courseware," as many large publishers now refer to it) includes other materials such as teacher manuals, student workbooks, and suggested activities, are these materials clearly written and appropriate to the topic being presented?

--Is all documentation accompanying this software clear and thorough?

--Above all, does this program present material in a logical and coherent way? Is the methodology of this software consistent with successful educational techniques?

Again, you should devise a systematic way of comparing the software that you review. A simple standardized form allows you to compare software at a glance. You will want to include your answers to the above questions on your evaluation form. Whenever possible, make your reviews available to other teachers who must evaluate software. This will make everyone's job simpler.

Locating Software for Evaluation

More than likely, you will begin your search for educational software in a computer retail store. You will probably be disappointed with the limited selection that most stores offer. As microcomputers become increasingly popular, this will certainly change and retail stores will offer a wider range of high-quality software products. Do not hesitate to ask the computer salesperson for direction in locating the kind of software you need for your classroom. Many salespeople are familiar with what is available on the market and can guide you toward other sources.

There are two types of computer stores stressing software that are now emerging and are likely to become more popular. One type is The Program Store in Washington D. C. and Baltimore, Maryland. This store offers more than 1,000 pieces of software and three different micro-computers to run and review software. The Program Store plans to open franchises throughout the country within the next several years.

Another type of software outlet is Food for Thought in Tucson, Arizona. Food for Thought is a club requiring membership dues. These dues entitle members to computer

TABLE 1:

Criteria for Evaluating Software for Educational Applications

--Suitable for grade and ability levels of your students?

--Hardware required?

--Interesting enough to encourage repeated use?

--Simple correction and editing procedures?

--Variable speed of presentation?

--Automatic warning of typing errors?

--Capable of addressing students by name?

--Effective positive reinforcement of correct responses?

--Effective negative reinforcement?

--More effective than textbooks or workbooks?

--Legible and attractive video display?

--Effective graphics?

--Relatively error-free?

--Clear and appropriate accompanying materials?

--Concise and thorough documentation?

--Based on sound educational methodology?

time and use of the club's software library. Club members are able to communicate with each other about their projects and interests. People affiliated with groups like this can be an excellent source of information to you as you search for programs to implement in your classroom.

One of your most fruitful sources of information about educational software will be other teachers and administrators who use software similar to that you are now considering. These people have been through the process of locating, acquiring and evaluating software of many kinds. Their experience can benefit you in your own search since they know of software sources and can give you a clear idea of what you should look for.

Educational Software Directories

In an attempt to clear a path through the jungle of educational software, several educational software directories have been published. Although these directories do not attempt to compare or evaluate available software, they do offer fairly comprehensive lists of software sources. The following list of directories should serve as a starting point.

The Apple Software Directory
Volume 3, Education
WIDL Video
5245 W. Diversey
Chicago, IL 60639
312-622-9606

Educational Software Directory
(for Apple II)
Sterling Swift Publishing Co.
P. O. Box 188
Manchaca, TX 78652

School Microware
(for Apple, PET, TRS-80)
Dresden Associates
P. O. Box 246
Dresden, ME 04342

TRS-80 Software Source
COMPUTERMAT
P. O. Box 1664
Lake Havasu City, AZ 86403

Atari Program Exchange
Atari, Inc.
P. O. Box 427
155 Moffett Park Dr.
Sunnyvale, CA 94086

80 Software Critique
RWC Microcomputing Services
P. O. Box 134
El Dorado, CA 95623

Educator's Handbook & Software Directory
(for Apple)
Vital Information, Inc.
350 Union Station
Kansas City, MO 64108

TRS-80 Software Directory
Vital Information, Inc.
350 Union Station
Kansas City, MO 64108

Unfortunately, the ease of copying computer software makes it unprofitable for software developers to distribute examination copies of programs as publishers do with textbooks. However, you may try to obtain copies on a trial basis by writing a letter on the letterhead stationery of your school district, indicating to the publisher who will guarantee the safety of the software, and promising not to pirate the programs. Most software distributors who do not send examination copies do have generous policies of refunding money to customers who find software unsatisfactory. This should relieve some of the pressure to make choices from among the many programs, good and bad, on the market.

When writing to a software publisher, be sure to state your particular needs specifically. When possible, list precise titles of the programs you wish to review. In addition, tell the publisher what subject areas you wish to teach, specific topics that you plan to cover, and what grade level you are teaching. With this information, the publisher can suggest software that will meet the needs you have outlined.

Still another source of information about educational software is microcomputer manufacturers. They may be in the process of developing just the sort of software you want, or they may be able to direct you to other sources of software that can be run on their machines. Microcomputer manufacturers will offer you valuable information about making maximal use of the computer in your classroom.

As microcomputer software becomes a more profitable business venture, major publishers are getting into the act. Sales representatives from these publishing companies will be happy to discuss your software needs and show you the products that their companies offer. Talk to several sales representatives from different publishers so that you know what software is available and how types of courseware differ. Several major publishing companies now offering educational software are McGraw-Hill, Milliken, Scott Foresman, Random House, SRA, DLM, and Addison-Wesley.

Software Review Publications and Organizations

You will find reviews of current software in a number of places. Many popular computer magazines run regular columns and special features that keep tabs on new software as it is produced. Among others, Creative Computing, Nibble Instructor, and Infoworld offer such informative reviews.

There are also a number of organizations that have formed to help direct teachers and other computer users to the best available software. One such project is Microsift, which aims to disseminate software evaluation information. Microsift publishes a newsletter that you will find interesting and helpful as you shop for high quality software. Microsift and a number of similar organizations can be contacted at the addresses below:

Microcomputer Research Clinic
Arizona State University
222 Payne Building (Education)
Tempe, AZ 85287

Microsift News
Northwest Regional Educational Laboratory
300 SW Sixth Ave.
Portland, OR 97204
(503)248-6800

California Software Evaluation Forum
"The 1983 Educational Software Prev. Guide"
Sanmaleo County Office of Education
333 Main Street
Redwood City, CA 94063

TABS Project
Ayss Hall 202-A
1945 N. High Street
Columbus, OH 43210

Project Local
200 Nahatan Street
Westwood, MA 02080

Educational Technology Center
University of California
Irvine, CA 92717
(714)883-6945

Apple Computer Clearinghouse for the Handicapped
Prentke Romich Co.
R.D. 2, P.O. Box 191
Shreve, OH 44676
(216)767-2906

Electronic Data Systems Group
14580 Midway Road
Dallas, TX 75234

Technical Ed. Research Centers
8 Eliot Street
Cambridge, MA 02138

EPIE Institute
P.O. Box 620
Stony Brook, NY 11790
(516)246-8664

Dataspan
University of Michigan
109 E. Madison St.
Ann Arbor, MI 48104
(313)763-4410

Problems with Current Software

As does any new field, software development has a number of problems to resolve. You should beware of some of the pitfalls of educational software that is currently available so that you do not purchase programs that are ultimately more frustrating than useful.

Peter Coburn, et al., (1982) have attempted to point out some of the problems faced by the teacher looking for good educational software. First, there is a plethora of available programs from an infinite number of sources. This can sometimes make shopping for software a hit-and-miss endeavor. To help eliminate some of this confusion, it is likely that on-line data bases will be developed to offer comprehensive lists of software sources. Software reviews may even be made accessible in this form.

Second, there are few programming languages and tools that have been designed especially for use in a traditional classroom setting. As discussed earlier, LOGO and PILOT are two such languages that serve this purpose. Probably this dilemma will resolve itself in the future as software and hardware developers respond to the special needs of classroom teachers.

Third, a majority of the software available now falls under the heading of drill and practice programs. There are too few educational games and simulation programs. This is probably attributable to publishers' reluctance to develop material that is not based on traditional teaching methods. Unfortunately, drill and practice software does not maximize the capabilities of the microcomputer. Teachers can have a substantial impact on the development of more attractive software packages by writing to software publishers and encouraging them to venture out into less traditional methods of presentation.

Fourth, teachers must consider the problem of machine incompatibility when they purchase software. A program written to be run on one brand of computer may not run on another machine. To alleviate this problem, a number of microcomputer manufacturers are now relying on CP/M, a common operating system. The major drawback of CP/M systems is that their initial purchase price is significantly higher than that of popular cassette systems. The higher cost of CP/M has been an obstacle in its adoption in school settings and, consequently, there is a shortage of CP/M-based educational software.

The unfortunate fact is that there is simply a dearth of high-quality software. Much of the software currently available has been developed either by computer hobbyists or by classroom teachers concerned with creating effective instructional materials. The problem with this is that although computer hobbyists have some degree of expertise in computer programming, they usually do not have a thorough knowledge of educational methods. On the other hand, classroom teachers are certainly experts in methodology, but few of them have the programming skills necessary to compose sophisticated software (Zalewski, et al., 1982).

Developing Your Own Software

If you find that you are unable to purchase prepackaged software that adequately meets the needs of your students, you have another exciting alternative: develop your own programs. Of course, the primary disadvantage of developing your own software is that the process is time-consuming and complicated. The planning stage of programming is particularly important. You will want to construct a complete flowchart before beginning to write your program. The time spent in the planning phase will pay off later in a better program with fewer bugs.

If you are writing a relatively simple program that includes true/false and multiple-choice responses, you may use any one of a number of author languages that allow you to write programs without having knowledge of more complex programming languages. Several such languages are PILOT, GENIS I, and TUTOR. You can learn the fundamentals of these languages in a very short period of time.

Should you find that you wish to construct more sophisticated software, you will probably need to study a programming language. You might consider enrolling in a class offered by a local university, community college or technical school. Or you may prefer to teach yourself to program by studying one of the many books written on the subject of various programming languages. BASIC is the most common language used for programming of this nature.

Do not hesitate to call on computer experts for assistance as you begin your programming efforts. Oftentimes, computer students prove helpful. Take advantage of the skills that advanced computer students at local high schools have gained in their classes. Not only will they help you, but they will also gain practical experience in the process.

Probably the most important factor to keep in mind as you write your own software is that your students function at a number of different levels of ability. Plan for contingencies and account for them in your program.

The more flexible your program, the more effective it will be.

If you run into unexpected problems as you write your own programs, you may find it helpful to consult the MECC (1980) publication A Guide to Developing Instructional Software for the Apple II. This excellent book offers a number of practical hints for composing programs that perform the way they are intended to.

Whether you purchase prepackaged software or develop your own, good programs make your classroom computer an extremely effective tool of learning. Computer education is the way of the future. As this trend continues, we will certainly see more and better educational software developing to meet the needs of teachers who want to make the most of the microcomputers in their classrooms.

REFERENCES

Bitter, Gary G. Computers in Today's World. New York, John Wiley and Sons, 1983.

Bitter, Gary G. and Camuse, Ruth. Using a Microcomputer In The Classroom. Reston, VA: Reston Publishing, 1983.

Coburn, Peter, et al. Practical Guide to Computers in Education. Reading, MA: Addison-Wesley Publishing Company, 1982.

Zalewski, Donald L., Ed. Microcomputers for Teachers--With Application to Mathematics and Science. School Science and Mathematics Association, 1982.

DESIGNING USER FRIENDLY SOFTWARE

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School & Home CourseWare, Inc.
1341 Bulldog Lane, Suite C
Fresno, CA 93710
(209) 227-4341

If you don't have
time to do it
right the first time,
where will you find
time to fix the
mistakes you made!!

The sooner you start to code
The longer it will take.

Introduction

In the summer of 1982 I had the tremendously rewarding opportunity of teaching educational software design to five classes of educators on both east and west coasts. Although the courses were originally planned with a prerequisite of at least intermediate programming skill, I discovered, to my surprise, that most of the course registrants had little or no knowledge of a programming language. In fact, many of them had little exposure to computers!

Also to my surprise, however, at the end of all the three-week sessions, from more than 75 students I came away with 20 excellent program designs, designs I will be proud to produce in the coming months.

The secret of my students' success is not really a secret. Any experienced classroom teacher who knows his or her subject and who knows kids should be able to design a short program for a personal computer. A good program design depends upon the perspective of the designer. If the designer approaches the experience from the user's point of view without regard to limitations which may be imposed by hardware or programmer, a good design is almost always possible. By using the proper working tools, you can give an idea to a high-school student, to a college student, or even to a 6th grade student for coding and he or she can prepare a running version as you visualized it.

The rest of this chapter describes the tools which allow you, the educator, to communicate program ideas to yourself--or for others--to code. (To illustrate this process, you will find a complete educational program, SPELL-N-TIME, in the Appendix.)

The six steps

Designing programs to be used as instructional media tools in the classroom is a planning and writing of educational curriculum combined with techniques used in TV and movies. The six steps which I'll discuss in detail are:

-Statement of the problem.

-Writing objectives.

-Creating a storyboard.

-Writing pseudocode.

-Manual walkthrough.

-Coding and documentation.

(Scan the program in the Appendix. Can you recognize any of the above steps?)

Statement of the problem

Too often, the first thing we do when we get an idea is to sit down at our computer and start typing. But fuzzy goals yield fuzzy results and waste much time by forcing many revisions of our plans as we go along. Please refresh your memory right now by re-reading the "proverbs' at the beginning of this paper.

Stating a problem involves looking at a problem your students have, not a problem you, the teacher, have. For example, suppose your students are having a problem remembering how to spell certain words. That means you are not reaching them with a traditional methods. How can a new method, using the computer, be designed?

A statement of the problem, then, might be, "Traditional methods used in the time available do not seem to motivate my students or to permit them enough time-on-task to master spelling skills for their current vocabulary".

Notice that the problem statement tells you what to expect as an outcome to a successful solution: Your students will have time enough time-on-task to master spelling skills for their current vocabulary.

You need to understand the problem as your students encounter it. Observe how they succeed, how they fail. Begin to think about the ideal solution for the student. As Polya noted in his classic, How to Solve It, "Think on the end before you begin (3)."

Next, we develop specific objectives for our instructions to the computer. What exactly you do want to happen, at what time in the program, so your students will achieve mastery of the spelling skills?

Writing Objectives

Your first concern is to make certain that you take advantage of what a computer can do more effectively than the printed word. You will take pains not to program what Johnny and Sally can do more efficiently with pencil and paper or with a book.

In short, just becuase you can write a computer program to help a student learn does not mean that you should write it. To design and write a first-rate, well-documented short program will take you over 40 hours if you are quite skilled. Be certain your program has high odds that it will be superior to what can be done with pencil and paper or any other traditional medium.

You should focus your efforts at program design on those tasks, those ideas, which use the following, and other peculiar talents of the computer:

Ability to adjust in milliseconds to the rate of learning of the student, whether slow or fast.

Ability to motivate through instant feedback, timing, scoring, color graphics, sound and animation.

Ability to sum up the student's performance and needs in seconds without need to distract you from other more important duties of one-to-one teaching.

Ability to show graphically the pattern of the student's errors, to compute the level of mastery of task and to estimate the time the student requires to achieve mastery.

Ability to aid in diagnosis and to reduce the drudgery of the clerical tasks of paperwork and record-keeping.

We expect the objectives of the spelling program we are designing to reflect these computer abilities. We might select features to make our program more effective such as:

a. Flash words at varying speed based on word length and accuracy of the student so as to increase chances of success for the slow learner or to challenge the capacity of the gifted.

b. Second try — flash syllables instead of the whole word. Research indicates this helps spelling skills.

c. Third try — display the word on the screen until it is correctly typed. Give the learner a feeling of "Hooray, I copied it right!" rather than "Phooey! I failed to spell it right."

d. Compute a score based on time and accuracy — like an educational pinball machine.

e. Report the number of words correct as well as score.

f. Display the list of mis-spelled words at end of game.

g. Enable the teacher to change the words for today's vocabulary, even to Spanish or French.

h. Give the teacher control over how many words are presented in a game.

These objectives do not by any means exhaust the capabilities of the computer. My purpose here is, of course, to demonstrate what you can do with a short program.

For example, other special skills of the computer enable you to achieve user-friendly advantages such as these:

Give the student control of movement forward or backward in a step-by-step development.

Simulate difficult, time-consuming, or dangerous events such as the Three-Mile Island nuclear accident.

Armed with your objectives, you need to determine a plan to solve the student's problem with mastery of spelling. That brings us to the storyboard technique. (Where in the documentation in the Appendix do you find the objectives?)

Creating a Storyboard

Assume you have defined your objectives with clarity. Then you must detail the step-by-step sequence to work toward each objective from the teaching point of view: Exactly what will the user experience?

Most methods or procedures for designing programs appear weakest at this point.

A technique used for decades in the movie, animation and TV industries is the storyboard. It is a simple technique to show graphically what is to occur, frame by frame for film, or second by second for the computer. This is how it works in film:

> Tack a set of 3x5 cards (or equivalent) to a bulletin board (Figure 1).
>
> Sketch on each card a 'scene' which indicates whether the scene is a long shot, medium shot, closeup, or extreme closeup.
>
> Write on each card a description of the action in that scene.
>
> Change the scene sequence, if desired, by moving cards about on the backing as you plan the project.

Cards may be altered, removed or replaced to reflect changes in sequence or decisions on scenes.

This technique fits easily into the task of planning a computer lesson or a program. Rather than 3x5 cards, you should use graph paper. Select paper with the same width as the number of characters per line and the same height as the number of lines on the computer screen. The result should be a layout which is carefully spaced to show how the material is to appear on the screen (Figure 2).

When a number of messages appear on the same background, or 'board,' overlays can be made. (Figures 3-7).

A conclusion to the 'game' appears in Figures 8 and 9.

FIGURE 1

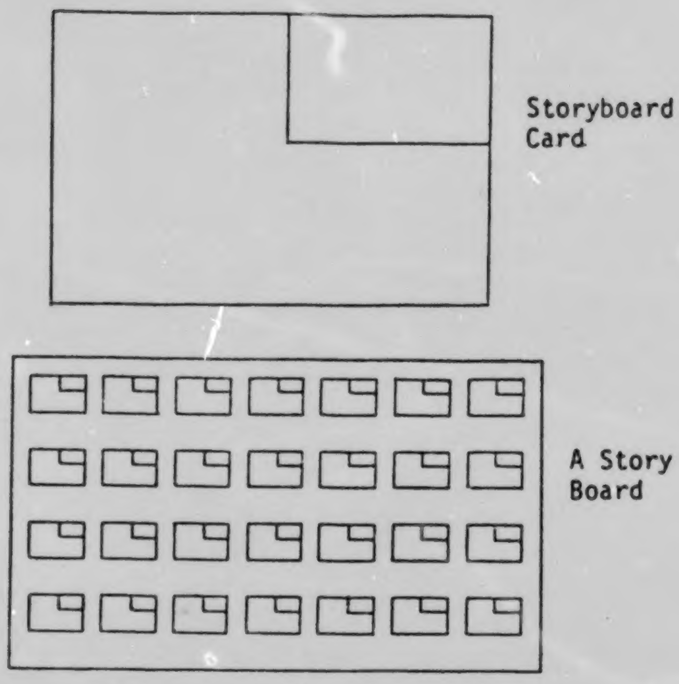

Storyboard Card
A Story Board

FIGURE 2

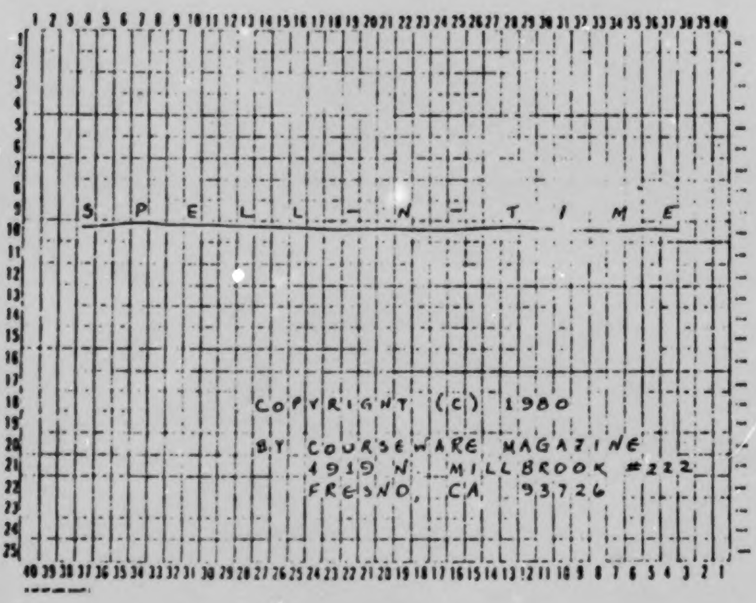
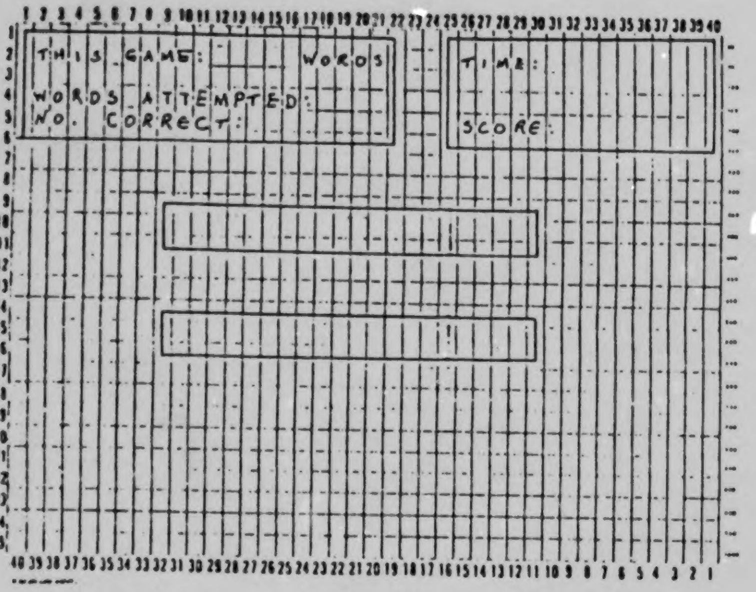

S P E L L - N - T I M E
COPYRIGHT (C) 1980
BY COURSEWARE MAGAZINE
4919 N. MILLBROOK #222
FRESNO, CA. 93726

FIGURE 3



THIS GAME: WORDS

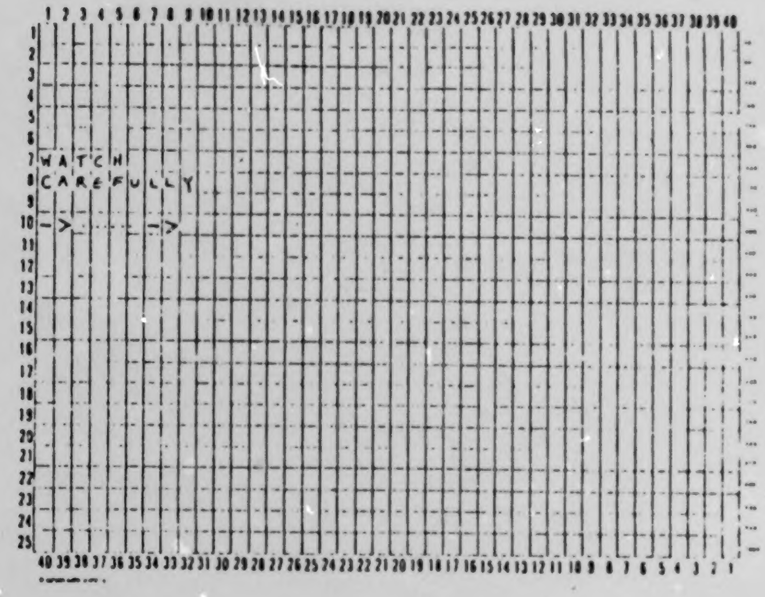
WORDS ATTEMPTED:

NO. CORRECT:

TIME:

SCORE:

FIGURE 4

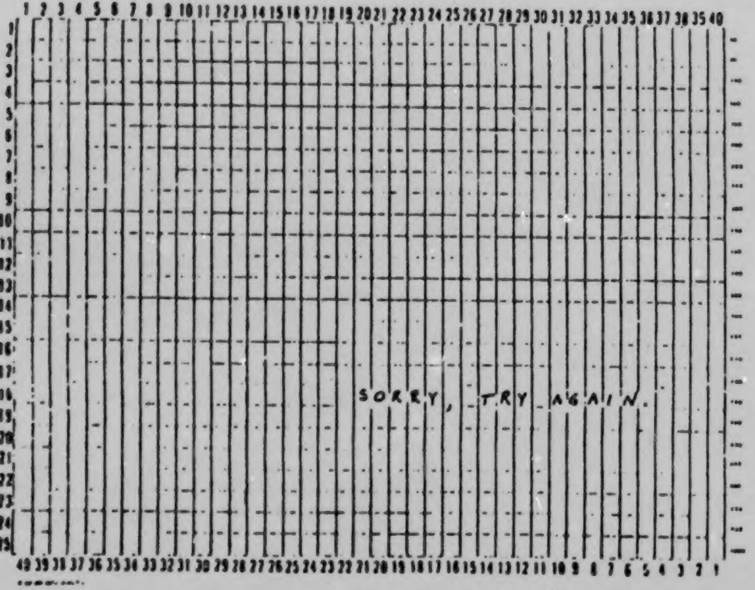


WATCH

CAREFULLY

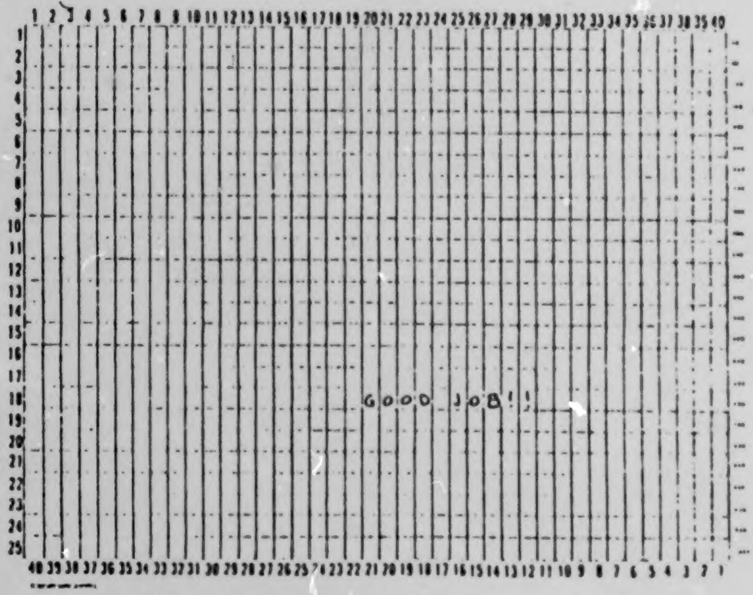
-> ->

FIGURE 5



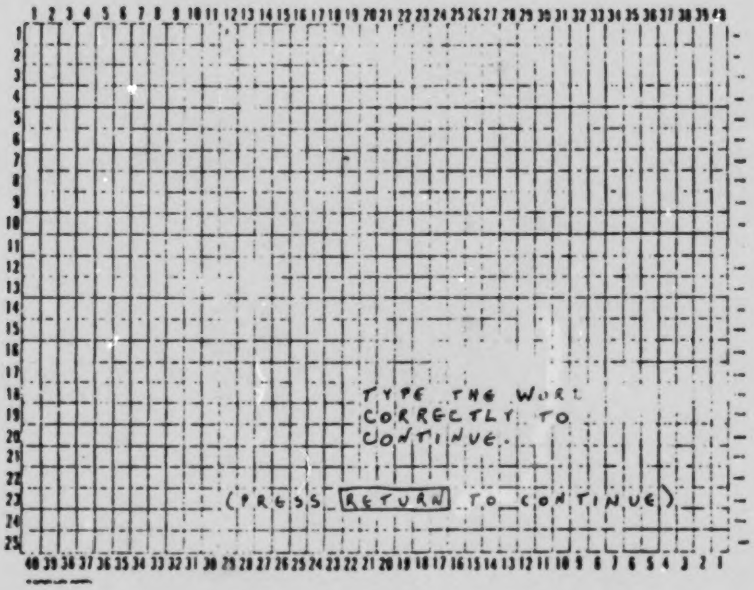
SORRY, TRY AGAIN.

FIGURE 6



GOOD JOB!!

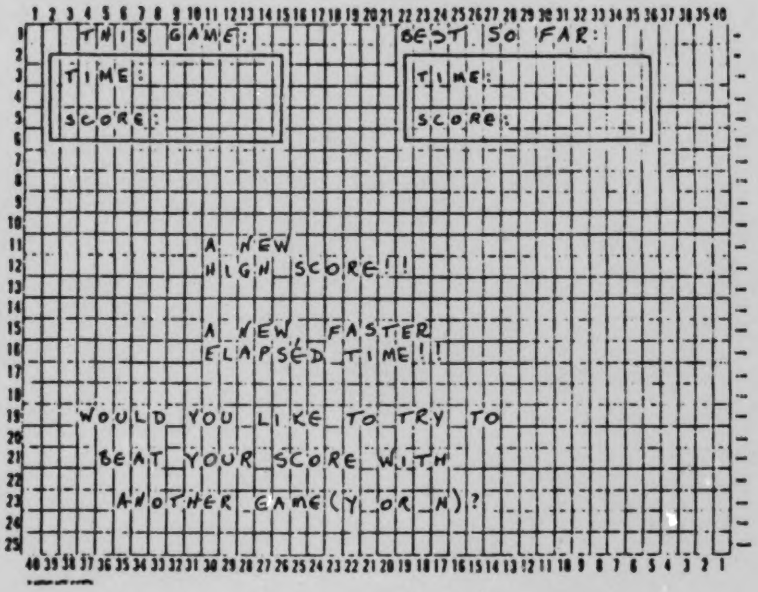
FIGURE 7



TYPE THE WORD
CORRECTLY TO
CONTINUE.

(PRESS RETURN TO CONTINUE)

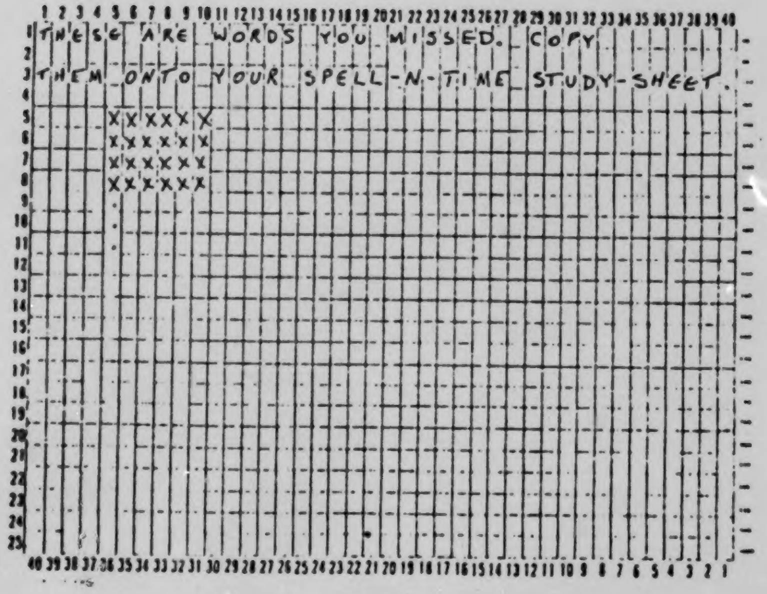
FIGURE 8



```
THIS GAME:                  BEST SO FAR:
 TIME:                       TIME:
 SCORE:                      SCORE:

          A NEW
          HIGH SCORE!!

          A NEW FASTER
          ELAPSED TIME!!

  WOULD YOU LIKE TO TRY TO
    BEAT YOUR SCORE WITH
      ANOTHER GAME(Y OR N)?
```

Figure 8

FIGURE 9



```
THESE ARE WORDS YOU MISSED. COPY
THEM ONTO YOUR SPELL-N-TIME STUDY-SHEET.
    XXXXXX
    XXXXXX
    XXXXXX
    XXXXXX
```

Figure 9

With the storyboard created you should test each objective while viewing the storyboard as if the program actually were on screen. You can discover incorrect logic or see where the student-machine interaction can be refined. With this type of preparation you should seldom be surprised by a strange screen display. At this stage you can easily add missing experiences. Once the program is written, additions are messy.

Satisfied with the storyboard, you can turn to writing a plain English statement of the program, the 'pseudocode'. (Where in the documentation in the Appendix do you find the storyboard or evidence one was prepared?)

Writing the pseudocode

As program designer, you have given the 'frames' in the storyboard a passing grade and you turn to laying out the logic of the program in 'pseudocode'. Pseudocode is written in simple English logic. It is not a programming language or code such as BASIC code, COBOL code or FORTRAN code. The pseudocode stage is important since it is a logically clear statement and easy to translate into a target computer language.

Start writing the pseudocode with a statement of the problem. Refine that statement repeatedly until no more refinement is needed. The major logic steps of our problem are:

a. print title page.

b. play the game.

c. display the mis-spelled words.

d. Conclusion — comparison of this game with the best score attained previously.

Compare the final pseudocode logic in the appendix with the storyboards above. How does the pseudocode relate to the story board?

You do not need to follow every step of the pseudocode logic. We have not described each program detail. But notice the use of indentations and underlining of IF, THEN, ELSE and WHILE words.

Take the first module, SET START TIME. It is a logical whole. It requires several, or many, steps in any given programming language but it can be grasped easily by the reader. If you were studying a program coded in a specific computer language, often you would be asking questions like, 'What are these five lines doing?'

Manual walkthrough

You still haven't written a single line of code. But if you continually debug your logic as you go along, there should be few, if any, bugs in your final coding.

Before the coding step, once again you should 'walk through' the pseudocode, testing every possible branch and concept. You check to verify that each module will do logically what it was designed to do. Then, and only then, should you start coding.

Coding and documentation

Select your programming language, arm yourself with paper and pencil, and prepare to code your program based on your pseudocode logic. Coding with paper and pencil will lead to fewer errors and less wasted time than coding at the keyboard. You should code each logic module separately from every other module. And you should use modular, structured, top down, one-way-in, one-way-out programming style (explaining those concepts takes another paper*).

---

*Send $4.00 (includes shipping and handling) for "What is Top-Down, Structured, Modular, One-way-in, One-way-out, Programming style" to School & Home CourseWare, Inc., 1341 Bulldog Lane, Suite C, Fresno, CA 93710.

Proper documentation inside the program code as you write it must include (see coding example, in Appendix):

- many, many REMarks.
- 'paragraphing' with spaces, horizontal lines and paragraph headings for each module and subroutine.

External documentation of an educational computer program should include (p. 3, Appendix):

- computer languages available for the program.
- subject area covered.
- grade level.
- an abstract of the program.
- basic instructional use.
- how the teacher can personalize the program for his/her classroom (appendix, p. 4).
- pseudocode (appendix, p. 6).
- description of variables (appendix, p. 9)
- an index of subroutines used (appendix, p. 10)
- a complete program listing.
- a student guide with student objectives and student worksheet or record sheet (appendix, pp. 17-18).

Summary

You will note that this chapter did not specify a computer language, e.g., BASIC, PASCAL, etc. How you design an educational computer program is independent of the language you use. This is essential if the final program is to be understood by anyone except the program's author.

A program can be used only as an instructional media tool or it can be given additional use as a model to teach programming. As an instructional media tool, it must adapt to the needs of a teacher who usually is a non-programmer. As a model and a tool to teach programming, it should be an example of clarity and readability. We use Shakespeare to teach English, why do less to teach programming?

Suggested reading

(1) Goodman, S. E., and Hedetniemi, S. T. Introduction to the Design and Analysis of Algorithms. New York: McGraw Hill Book Company, 1977. pp. 18-35.

(2) Nevison, John M. The Little Book of BASIC style: How You Can Write a Program You Can Read. Reading, MA: Addison-Wesley Publishing Company, 1978.

(3) Polya, G., How to Solve It. Doubleday Anchor Books, Garden City, N.Y. 1957.

(4) Schneider, G. Michael, Weingart, Stephen W., and Perlman, David M. An Introduction to Programming and Problem Solving with PASCAL. New York: John Wiley and Sonce, 1978.

APPENDIX

SPELL-N-TIME

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Computer languages available: Applesoft BASIC 16K
PET BASIC 8K
TRS-80 Level 2 BASIC 16K

Subject areas: All

Grade levels: All

Objectives: After spelling practice with a computer-presented, randomly-selected subset of a set of words chosen by the teacher, the student's computer score will increase and the student's time to complete a spelling exercise will decrease. (Student score is based on spelling accuracy and time.)

Abstract: The computer flashes a whole word; the student must type the correctly spelled word. A second chance is given for incorrect responses, but this time the syllables of the word are flashed in sequence (if more than one syllable). After a second incorrect response, the word is retained on the screen and the student must type it correctly before the game will continue. Score is based on time and accuracy.

Presentation-time of words varies depending upon the ability of the user: a series of incorrect responses will cause slower presentation-time, a series of correct responses will cause faster presentation-time. At the end of each game, a list of mis-spelled words will appear on the screen for the student to write on his/her worksheet.

Basic instruction use: This program is designed as a fun drill in spelling words and in sight recognition of words. It can be used to advantage in any curriculum area where sight recognition and spelling is considered important.

The teacher has control of the vocabulary used and may change or update the vocabulary list daily. The teacher also controls the number of words to be presented to the student during each "game."

Many teachers will create a separate tape for each day's lesson with only the new words for that lesson in the vocabulary list. Spanish or French students (for example) who were absent from a class drill might use the computer review to catch up on what they missed.

Why use the SPELL-N-TIME program? SPELL-N-TIME is a dynamic experience which allows all students to be successful, it makes full use of the computer's unusual talents. Because presentation-time of words in the program is dependent on student skill, weak students are allowed more time to recognize and spell a word, while stronger students are given less time. This permits weaker students to feel success a high percentage of the time because they are correctly spelling words even though their score may be held down because of slower achievement times.

Immediate feedback and high percentage of success is a great motivator--nothing succeeds like success. Neither flash cards nor worksheets have this ability to motivate. You, as teacher, can motivate by personal, one-to-one attention, but you haven't the time, the patience, or the ability to adjust and to keep score that your personal microcomputer has.

How to select the number of words presented in each game: Line 173 (variable: NW) determines the number of words the student will be exposed to in each game. You may change this line by typing:

```
173 NW = 25
```

if you wish 25 words to be presented in each game, or:

```
173 NW = 32
```

if you wish 32 words to be presented.

Line 173 may be changed by the teacher or user after the program is loaded, or may be changed and the altered program saved on a different tape. (You might title the new program SPELL-N-TIME-32 if NW=32.)

How to insert a teacher-chosen vocabulary: Lines 174 through 198 are reservedd for DATA words. You should have at least as many words on those lines as variable NW is set to on line 173. As written, the program will allow for a maximum of 50 words (DIM R$(50)). To store more words (if the size of your computer's memory will allow), change line 167 to:

```
167 DIM R$(60)
```

or

```
167 DIM R$(100)
```

if you wish to store 60 (or 100) words.

The sample data words are from Spell Correctly, Edition 5, Silver Burdett, 1974. To remove the sample DATA words in preparation for entering your own vocabulary, erase each existing DATA line by typing a line number follwed by a RETURN (or ENTER), thus:

```
174↓      ( ↓ means RETURN)
175↓
176↓
   etc.
```

Here is a sample vocabulary being added. Type a line number, followed by the word DATA, followed by your DATA words (with a hyphen between each syllable) separated by commas (no comma at the end of a line, though). Put no spaces after commas between words. Thus:

```
174 DATA dy-nam-ic,ex-per-i-ence,al-lows,all,stu-dents,suc-ce
ss-ful,da-ta
175 DATA be-cause,pre-sen-ta-tion
```

and so on.

A PET DATA line may be up to 80 characters long (two screen lines). A TRS-80 DATA line may be up to 241 characters long (i.e. about 3 2/3 screen lines), while an Apple II DATA line may be up to 239 characters long.

How to open binder to remove pages for copying: The white, plastic spine may be opened for easy paper removal by simply pulling apart with the fingers. The spine snaps closed by squeezing.

(For PET owners only)
How to fit a 9.2K program into an 8K PET:

You'll notice that the number of bytes used in the program listing is 9231. How can that program possibly fit in an 8K machine?

After writing, entering, running and debugging the completely documented program, we removed every non-essential REM line and REMark. That way, if you need to make changes to the program, your line numbers will be the same as in the listed program. The actual, running program length is about 7K--and therefore fits nicely in an 8K machine.

Procedure

```
1.0 Introduction and Title Page.

2.0 LOOP

  2.1 Initialize all constants and read vocabulary words into
      array R$.

  2.2 Draw 4 windows and display number of words in game. Press
      RETURN.

  2.3 For words attempted (WA) = 1 to number of words per game (NW)

    2.3a  set start time (BG) and select a word (W$),

    2.3b  remove hyphens from data word and store in variable
          (FH$),

    2.3c  also store syllables in array (FW$(J)).

    2.3d  if first try (FL=0)

             then store FH$ also in F$,
                  display "watch carefully" and arrow,
                  flash word,
                  get response (GT$),
                  update time.

                  if response is correct

                     then    increase score (SC),
                             add 1 to number correct (NC),
                             print praise message,
                             add 1 to consecutive correct counter
                               (CCC),
                             set consecutive incorrect counter
                               (CIC) to zero,
                             update windows,
                             press return,
                             erase answer and message.

                     else    print sorry message,
                             add 1 to consecutive incorrect
                               counter (CIC),
                             set consecutive correct counter
                               (CCC) to zero,
                             set attempt flag = 1 (FL),
                             increment missed-word counter (I),
                             store missed word (MW$(I)),
                             erase answer and message.
```

```
2.3e  if second try (FL=1)
        then display "watch carefully" and arrow,
             flash syllables,
             get response (GT$),
             update time,

             if response is correct

                then    increase score,
                        print praise message,
                        update windows,
                        press RETURN,
                        erase answer and message.

                else    print "type the word correctly to
                          continue."
                        set attempt flag = 2 (FL).

2.3f  if third try (FL=2)

        then display word (do not erase),
             get response,
             while response is incorrect
                       press return,
                       erase answer and message,
                       get response.
             increase score,
             update windows,
             press RETURN,
             erase flash window,
             erase answer and message.

2.3g  if word was answered correctly on first try (FL=0)

        then swap word used with last word in array,
             decrement number-of-words counter (N).

2.4 Compute elapsed time for game.

2.5 List words missed. Press RETURN.
```

```
  2.6 Print a frame with time and score comparison to best so far.
    2.6a if score is better than best so far
         then  flash "A new high score!!"
               save new high (BS).
    2.6b if time is better than best so far
         then  flash "A new, faster elapsed time!!"
               save new elapsed time (BT).
  2.7 Query if user wants to try another game.
3.0 END
```

Description of Variables

AW$	cursor to answer window
BG	start time of game
BS	best score so far
BT	best time so far
CIC	consecutive incorrect counter
CCC	consecutive incorrect counter
C1-C4	save cursor location
ER$	erase 20 spaces
ET	elapsed time of game
FH$	flash word without hyphens
FL	attempt flag
FT	flash time
FW$	cursor to flash window
FW$()	syllables of word
GT$	response
I	missed-word index counter
LP	left pointer
MW$()	missed words
N	number of words in data list
NC	number correct
NC$	cursor to number correct
NW	number of words per game
P5	pause in seconds
PR$	cursor to press-return phrase
PW$	cursor to praise window
R	random number
R$()	random-word array
RP	right pointer
RW	random-word pointer
R9$	cursor 9 right
SC	score
SC$	cursor to score
T$	temporary storage
TI	internal timer in 60ths
TS	start time
TW$	cursor to timer window
W$	randomly selected word
WA	words attempted
WA$	cursor to words-attempted
WCW$	cursor to word-count window

Subroutine Index

7100	update scoring windows
7200	flash words and syllables
7400	erase answer and message windows
7600	compute flash time
7800	watch carefully
8200	pause
8400	'get'
8600	timer
9000	press RETURN

```
*******************************************************
***        SPELL-N-TIME
                                         BYTES:  9231
                                         DATE:   9/17/80
                                         TIME:   19.08
*******************************************************

100 REM "SPELL-N-TIME"
105 POKE 59468,12 :REM GRAPHICS MODE
110 PT=PEEK(50003)
120 REM ==============================
122 REM      T I T L E   P A G E
124 REM ==============================
130 PRINT "SQQQQQQQQQ"
135 PRINT TAB(3);"S  P  E  L  L  -  N  -  T  I  M  E"
140 PRINT TAB(3);"___________________________________"
145 PRINT "QQQQQQQQ";TAB(14);"COPYRIGHT (C) 1980Q"
150 PRINT TAB(14);"BY COURSEWARE MAGAZINE"
155 PRINT TAB(17);"4919 N. MILLBROOK #222"
160 PRINT TAB(17);"FRESNO, CA  93726"
165 P5=4: GOSUB 8200 :REM PAUSE
167 DIM R$(50)
170 REM ==============================
171 REM  WORDS PER GAME & DATA WORDS
172 REM ==============================
173 NW=10 :REM # OF WORDS PER GAME
174 DATA A-BAN-DON,AC-CI-DENT,AC-CUS-TOMED,AD-DI-TION,AD-DRESS,AIL-MENT
175 DATA AL-TI-TUDE,A-MER-I-CAN,AP-PLAUD,A-PRON,AT-MOS-PHERE,AUNT,AU-TO-MA
176 DATA AU-TUMN,AV-E-NUE,AV-ER-AGE,AXLE,BA-CON,BAG-GAGE,BALD,BA-NAN-A,BAN
177 DATA BAN-NER,BARE,BARGE,BAR-REN,BASE-MENT,BASS,BAT-TLE,BEACH
178 DATA BEAST,BEAU-TY,BEEF,BE-GIN-NING,BE-HAVE,BE-LIEVE,BELT,BI-CY-CLE
179 DATA BLAN-KET
199 DATA "NO MORE WORDS"
200 REM ==============================
202 REM          INITIALIZE
204 REM ==============================
205 RESTORE
210 R9$="]]]]]]]]]|"
215 ER$="                        "
220 WCW$="SQ]]]]]]]]]]]]|"
225 TW$="SQ]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]|"
230 FW$="SQQQQQQQQQQ]]]]]]]]]]|"
235 AW$="SQQQQQQQQQQQQQQ]]]]]]]]]]|"
240 PR$="SQQQQQQQQQQQQQQQQQQQQQQQQQ]]]]]]]]]](PRESS RETURN TO CONTINUE)
245 PW$="SQQQQQQQQQQQQQQQQQ]]]]]]]]]]]]]]]]]]]|"
250 WA$="SQQQ]]]]]]]]]]]]]]]]]|"
255 NC$="SQQQQ]]]]]]]]]]]]]]]]]]|"
260 SC$="SQQQQ]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]|"
265 R=RND(-TI)
275 SC=0 :I=0
277 WA=0 :NC=0
280 C1=224-PT*28:C2=225-PT*28:C3=226-PT*28:C4=245-PT*29
282 :
284 REM  READ VOCAB. WDS INTO ARRAY R$
286 K=1
288 :
290 READ R$(K)
292 IF R$(K)="NO MORE WORDS" THEN N=K-1 :GO TO 300
294 K=K+1
296 GO TO 290
```

```
298 :
300 REM ================================
302 REM          DRAW 4 WINDOWS
304 REM ================================
310 PRINT "]┌──────────────────────┐  ┌──────────────┐"
315 PRINT  "│THIS GAME:       WORDS│  │TIME:         │"
320 PRINT  "│                      │  │              │"
325 PRINT  "│WORDS ATTEMPTED:      │  │              │"
330 PRINT  "│NO. CORRECT:          │  │SCORE:        │"
335 PRINT  "└──────────────────────┘  └──────────────┘QQ"
340 PRINT R9$;" ┌──────────────────────┐"
345 PRINT R9$;" │                      │"
350 PRINT R9$;" └──────────────────────┘QQ"
355 :
360 PRINT R9$;" ┌──────────────────────┐"
365 PRINT R9$;" │                      │"
370 PRINT R9$;" └──────────────────────┘"
410 IF N<NW THEN NW=N :REM FEWER THAN NW DATA WORDS.
415 PRINT WCW$;NW  :REM TO WORD COUNT WNDOW
430 PRINT TW$;00
435 GOSUB 7100 :REM UPDATE SCORING WNDW
485 GOSUB 9000 :REM PRESS RETURN
500 REM ================================
502 REM      SELECT AND FLASH WORDS
504 REM ================================
507 BG=TI :REM SET BEGIN TIME FOR GAME
510 FOR WA= 1 TO NW
515 R = INT(N*RND(1))+1
520 W$=R$(R) :REM SELECT A WORD
525 FL=0      :REM 'ATTEMPT' FLAG
530 :
535 IF FL<>0 THEN 720
540 REM ================================
545 REM  REMOVE HYPHENS FROM DATA WORD
547 REM ================================
550 FH$="" :J=1
555 LP=1 :REM  LEFT POINTER
560 FOR RP=1 TO LEN(W$)
565 IF MID$(W$,RP,1)<>"-" THEN 570
567 FW$(J)=MID$(W$,LP,RP-LP)
568 FH$=FH$+FW$(J)
569 LP=RP+1 :J=J+1
570 NEXT RP
573 FW$(J)=MID$(W$,LP,LEN(W$)+1-LP) :REM ATTACH LAST SYLLABLE
574 FH$=FH$+FW$(J)
580 REM ================================
582 REM           FIRST TRY
584 REM ================================
600 F$=FH$
602 GOSUB 7800 :REM 'WATCH CAREFULLY'
605 GOSUB 7200 :REM FLASH WORD
610 GOSUB 8400 :REM GET RESPONSE & UPDATE TIME
625 :
640 IF GT$<>FH$ THEN 680
642 SC=SC + INT(800*360/(TI-TS))
643 NC=NC+1 :REM ADD 1 TO # CORRECT
645 PRINT PW$;"GOOD JOB!!" :REM RIGHT
650 CCC=CCC+1 :REM CONSEC. CORRECT CTR.
655 CIC=0 :REM CONSEC. INCORRECT CTR.
```

```
657 GOSUB 7100 :REM UPDATE WINDOWS
660 GOSUB 9000
665 GOSUB 7400 :REM ERASE ANS & MESSG
670 GO TO 900
675 :
680 PRINT PW$;"SORRY, TRY AGAIN." :REM WRONG
685 CIC=CIC+1
690 CCC=0
695 FL=1
697 I=I+1
700 MW$(I)=FH$ :REM STORE MISSED WORD
705 GOSUB 9000
710 GOSUB 7400
712 REM ==============================
715 REM           SECOND TRY
717 REM ==============================
720 IF FL<>1 THEN 820
725 GOSUB 7800 :REM 'WATCH CAREFULLY'
730 FOR K=1 TO J :REM  FLASH SYLLABLES
735 F$=FW$(K) :GOSUB 7200
737 P5=.05 :GOSUB 8200
740 NEXT K
745 :
750 PRINT AW$;TAB(INT(20-LEN(FH$)/2));
755 GOSUB 8400
760 IF GT$<>FH$ THEN 875
765 SC=SC+INT(600*360/(TI-TS))
770 PRINT PW$;"THAT'S IT!!"
772 GOSUB 7100 :REM UPDATE WINDOWS
775 GOSUB 9000
780 GOSUB 7400
785 GO TO 900
790 :
800 PRINT PW$;"TYPE THE WORD"
805 PRINT PW$;"█CORRECTLY TO"
807 PRINT PW$; "██CONTINUE."
810 FL=2
812 REM ==============================
813 REM           THIRD TRY
815 REM ==============================
820 IF FL<2 THEN 900
825 PRINT FW$;TAB(INT(20-LEN(FH$)/2));FH$
830 PRINT AW$;TAB(INT(20-LEN(FH$)/2));
835 GOSUB 8400
840 :
845 IF GT$<>FH$ THEN 875
850 SC=SC+300
852 GOSUB 7100 :REM UPDATE WINDOWS
855 GOSUB 9000
857 PRINT FW$;ER$
860 GOSUB 7400
865 GO TO 900
870 :
875 GOSUB 9000
880 GOSUB 7400
885 GO TO 800 :REM WAIT FOR CORRECT RESPONSE
900 REM ==============================
902 REM          HOUSEKEEPING
904 REM ==============================
907 IF FL<>0 THEN 960 :REM DON'T SWAP IF WORD WAS MISSED.
915 :     REM SWAP USED WORD WITH 'LAST' WORD IN RANDOM ARRAY
920 T$=R$(R)
925 R$(R)=R$(N)
930 R$(N)=T$
935 N=N-1
940 :
960 NEXT WA
970 ET=INT((TI-BG)/60) :REM ELAPSED TIME FOR GAME
1000 REM ==============================
1002 REM        LIST WORDS MISSED
1004 REM ==============================
1010 IF I=0 THEN 1100 :REM NO ERRORS
1015 PRINT "⊐THESE ARE WORDS YOU MISSED. COPY◘"
1020 PRINT "THEM ONTO YOUR SPELL-N-TIME STUDY-SHEET."
1025 FOR K=1 TO I
1030 PRINT TAB(5);"ℜ";MW$(K)
1035 NEXT K
1040 GOSUB 9000
1100 REM ==============================
1102 REM      TIME-SCORE COMPARISON
1104 REM ==============================
1110 PRINT "⊐   THIS GAME:";TAB(22);"BEST SO FAR:"
1115 PRINT "  ┌────────────┐";TAB(22);"┌────────────┐"
1120 PRINT "  |TIME: ";ET;TAB(15);"|";TAB(22);"|TIME: ";BT;TAB(36);"|"
1125 PRINT "  |            |";TAB(22);"|            |"
1130 PRINT "  |SCORE:";SC;TAB(15);"|";TAB(22);"|SCORE:";BS;TAB(36);"|"
1135 PRINT "  └────────────┘";TAB(22);"└────────────┘◘◘"
1137 :
1139 IF BS=0 THEN 1170
1140 IF SC<=BS THEN 1173
1142 FOR ZK = 1 TO 20
1145 IF ZK/2 = INT(ZK/2) THEN 1162
1155 PRINT FW$;"ℜA NEW"
1160 PRINT TAB(11);"ℜHIGH SCORE!!"
1161 GO TO 1165
1162 PRINT FW$;"A NEW"
1163 PRINT TAB(11);"HIGH SCORE!!"
1165 NEXT ZK
1170 BS=SC :REM SAVE NEW HIGH
1172 :
1173 IF BT=0 THEN 1200
1174 IF ET>=BT THEN 1210
1176 FOR ZK = 1 TO 20
1178 IF ZK/2 = INT(ZK/2) THEN 1186
1180 PRINT AW$;TAB(14);"ℜA NEW, FASTER"
1182 PRINT TAB(18);"ℜELAPSED TIME!!"
1184 GO TO 1195
1186 PRINT AW$;TAB(14);"A NEW, FASTER"
1188 PRINT TAB(13);"ELAPSED TIME!!"
1195 NEXT ZK
1200 BT=ET :REM SAVE NEW TIME
1205 :
1210 PRINT "◘◘   WOULD YOU LIKE TO TRY TO"
1215 PRINT "◘      BEAT YOUR SCORE WITH "
1220 PRINT "◘        ANOTHER GAME (Y OR N)?"
1225 GET Q$ :IF Q$="" THEN 1225
1230 IF Q$="Y" THEN 200
1235 IF Q$<>"N" THEN 1225
```

```
1290 PRINT "NEND OF PROGRAM. TYPE :RUN■ TO START AGAIN"
1500 END
7100 REM ===============================
7102 REM   SUBR - UPDATE SCORING
7103 REM                 WINDOWS
7104 REM ===============================
7110 PRINT WA$;WA
7115 PRINT NC$;NC
7120 PRINT SC$;SC
7130 RETURN
7200 REM ===============================
7202 REM   SUBR - FLASH WORDS & SYLL
7204 REM ===============================
7215 GOSUB 7600 :REM 'CMPUTE FLASH TM'
7220 PRINT FW$;TAB(INT(20-LEN(F$)/2));F$ :REM  CENTER WORD AND DISPLAY IT
7225 TS=TI
7230 IF TI-TS < FT*60 THEN 7230 :REM FLASH TIME.
7235 PRINT FW$;ER$ :REM ERASE WORD
7240 :
7245 PRINT AW$;TAB(INT(20-LEN(FH$)/2));
7255 RETURN
7400 REM ===============================
7402 REM   SUBR - ERASE ANS & MESSG
7404 REM ===============================
7410 PRINT AW$;ER$
7415 PRINT PW$;ER$
7420 FOR ZK=1 TO 3
7425 PRINT TAB(19);ER$
7430 NEXT ZK
7435 RETURN
7600 REM ===============================
7602 REM   SUBR - COMPUTE FLASH TIME
7604 REM ===============================
7610 FT=.05*LEN(F$)
7615 IF CCC>2 THEN FT=FT-(CCC-3)*.1
7620 IF CIC>2 THEN FT=FT+(CIC-3)*.1
7625 RETURN
7800 REM ===============================
7802 REM     SUBR - WATCH CAREFULLY
7804 REM ===============================
7805 PRINT TW$;"    "
7810 PRINT "SQQQQQQWATCH"
7815 PRINT "CAREFULLYN"
7820 FOR ZK = 1 TO 7
7825 PRINT " ->▮▮▮"; :P5=.1 :GOSUB 8200
7830 NEXT ZK
7832 PRINT "SQQQQQQ";
7833 FOR ZK=1 TO 4 :PRINT "            " :NEXT :REM  ERASE.
7835 RETURN
8200 REM ===============================
8202 REM          SUBR - PAUSE
8204 REM ===============================
8210 FOR K6=1 TO 700*P5:NEXT K6
8215 RETURN
8400 REM ===============================
8402 REM          SUBR - 'GET'
8404 REM ===============================
8413 POKE 525-PT*367,0 :REM CLEAR INPUT BUFFER.
8415 GT$=""
```

```
8417 T5=TI :T4=1
8420 GET Q$ :IF Q$<>"" THEN 8510
8422 IF T5<=TI THEN PRINT MID$("ꓘ ■ ▌▌ ",T4,3);"▌▌"; :T4=5-T4 :T5=TI+15
8430 GOSUB 8600 :REM UPDATE THE TIMER
8485 GO TO 8560
8490 :
8510 IF Q$=CHR$(13) THEN PRINT " ▌▌" :RETURN
8515 IF Q$<>CHR$(20) THEN 8545 :REM  DELETE KEY.
8520 PRINT "▌▌  ▌▌▌";
8525 IF LEN(GT$)<=1 THEN GT$="" :REM  DELETE FROM STORED WORD.
8530 IF LEN(GT$)>1 THEN GT$=LEFT$(GT$,LEN(GT$)-1)
8535 GO TO 8560
8540 :
8545 GT$ = GT$+Q$ :REM CONCATENATE NEW LETTER TO WORD.
8550 PRINT Q$;
8560 GO TO 8420
8600 REM ==============================
8602 REM          SUBR - TIMER
8604 REM ==============================
8610 TA=PEEK(C1):TB=PEEK(C2):TC=PEEK(C3):TD=PEEK(C4) :REM SAVE CRSR LOC.
8620 PRINT TW$;INT((TI-TS)/60)
8630 POKE C1,TA:POKE C2,TB:POKE C3,TC:POKE C4,TD :REM RESTORE CRSR LOC.
8640 RETURN
9000 REM ==============================
9002 REM       SUBR - PRESS RETURN
9004 REM ==============================
9010 POKE 525-PT*367,0 :REM CLEAR KEYBOARD BUFFER.
9015 PRINT PR$  :REM   PRESS RETURN
9020 GET Q$ :IF Q$<>CHR$(13) THEN 9020
9025 PRINT "┐                                      "
9030 RETURN
63900 REM ==============================
63902 REM      PRINTER INSTRUCTIONS
63904 REM ==============================
63910 PP$ = "SPELL-N-TIME"
63990 INPUT "DATE";D$ :INPUT "TIME";T$
63991 PP$="**  "+PP$+"  **"
63992 OPEN4,4 :OPEN8,4,3 :PRINT#8,59 :T=80-3*LEN(PP$)
63993 PRINT#4,TAB(T); :FORK=1 TO (80-T) :PRINT#4,"*"; :NEXT
63994 PRINT#4,TAB(T)CHR$(1)CHR$(1)CHR$(147)PP$
63995 PRINT#4,TAB(60)"BYTES:"15359-FRE(0)
63996 PRINT#4,TAB(60);"DATE:  "D$ :PRINT#4,TAB(60);"TIME:  "T$
63998 PRINT#4,TAB(T); :FORK=1TO(80-T) :PRINT#4,"*"; :NEXT :CMD4 :LIST
READY.
```

SPELL-N-TIME

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CourseWare Magazine

Computer languages available: Applesoft BASIC 16K
PET BASIC 8K
TRS-80 Level 2 BASIC 16K

Subject areas: All

Grade levels: All

Abstract: The computer will flash a word, you are to type the word correctly spelled. If you mis-spell the given word, it will be flashed once more in syllables (if more than one syllable). If your second response is incorrect, the word will be held on the screen until you type it correctly.

Your score is based on speed and accuracy.

Objective: To improve your ability to recognize and spell words. Your score should improve as you play more games.

Use of your worksheet: At the end of each game, the words you are not sure of will be listed on the screen. Copy these words onto your worksheet so you can keep track of your progress, share your progress with your teacher, and practice words you are not comfortable with.

Study sheet

Student ____________________

Date __________ Class ________

LIST OF WORDS MIS-SPELLED OR INCORRECTLY RECOGNIZED

Game 1

____
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Game 2

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Game 3

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Game 4

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Game 5

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Game 6

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BEGINNING PROGRAMMING

by Bill Gulley

Purpose

This article describes types of programming languages, use and modification of software packages, and how educational users can learn more about programming.

Types of Computer Languages

The term software means "instructions for computers." It is a broad term and includes both general-purpose programming languages and software packages. To make matters more confusing, there are new hybrid forms. A general-purpose programming language can be used for a variety of tasks. A software package is a commercially-prepared program, written in a general-purpose language. For want of a better term, the new hybrid forms can be called user-oriented languages, since they are relatively simple to use and have been specifically designed for use by non-specialists.

General-Purpose Programming Languages

General-purpose programming languages can be divided into two broad groups: lower-level languages and higher-level languages. There are two types of lower-level languages: machine code and assembly code.

Machine code represents the very lowest level of software (closest to the actual electronic signals used by the computer itself). This code

(*code* means the same thing as *language*) looks like this:

01011101010100101010111010101010101010001010111010010101010.

Needless to say, writing programs in this language is tedious, error-prone and psychiatrically risky. Luckily, only specialists need ever use it (and even they seldom use it). All software must ultimately be translated into machine code, but this translation is itself automatically performed by still more software. This translation software (called a translator, compiler or interpreter) is either built-in to the computer or loaded using very simple commands, and presents no obstacle to users.

Assembly code is more widely used, but only by data processing specialists. Here is a sample:

```
BAL  R5,INPUT
LR   R3, PRICE
```

Assembly code is one step above machine code. Each statement can be easily translated into one group of machine codes. Many software packages are written in assembly code. Users usually cannot write assembly code. As a result, while assembly code programs are fast and efficient, they cannot be modified by users.

Both types of lower-level languages--machine and assembly--can be loosely referred to as "machine code." It is convenient to view machine code as being non-modifiable by most users, and leave it at that.

Higher-Level Languages

Higher-level languages are also called *source code*. They are the original source for later (automatic) translation into machine code or "object code." Except for commercially-prepared software packages, the vast majority of all programs are written in higher-level languages. Before proceeding to a discussion of the various languages, the significance of the higher/lower situation should be emphasized. Since all programs are ultimately translated into machine code, one computer can use many languages. This is a confusing point to many users, since most inexpensive small computers (called microcomputers) are sold with only one built-in language (BASIC). Most medium-price and higher-price microcomputers can be outfitted to use several languages.

Here is a thumbnail sketch of the major higher-level languages:

BASIC -- This is the most popular general-purpose language for users. It can be learned (on the simpler level) in 5 to 30 hours. In the past it was viewed as a weak language which was not suitable for serious purposes, but this attitude is changing. New "extended" or "business" BASIC's are quite powerful, and many complex problems can be solved with BASIC. Thirty to 100 hours are required to master the more complex BASIC's. By the way, "business" BASIC is quite suitable for educational uses since it emphasizes manipulation of English and user-oriented matters rather than scientific formulas.

While there are many versions of BASIC--each different--the most popular form is called Microsoft BASIC (after the company that distributed it) or MBASIC. It is so widespread that many call it generic BASIC. It is built-in to most inexpensive microcomputers, including Apple, IBM, Radio Shack, Atari and Texas Instruments.

COBOL and FORTRAN -- These two languages are the current standards for full-featured professional use. COBOL is a business-oriented language, while FORTRAN is scientifically-oriented. Both are standardized languages (unlike BASIC); an international committee fixes the syntax (choice and spelling of words) so that programs can be run on virtually any computer, worldwide. In general, users cannot use COBOL or FORTRAN effectively without taking a one-semester course, requiring from 150 to 200 hours of effort.

PASCAL and ADA -- These newer languages (along with others such as C and FORTH) are threatening the COBOL/FORTRAN preeminence, especially for microcomputers. PASCAL is most popular, but it is highly formalized and requires considerable logical precision. It was originally designed as a vehicle for teaching computer logic to computer science students. For many tasks, using PASCAL would be needlessly complicated since BASIC is both easier to use and equally capable.

User-Oriented Languages

The hybrid forms described below still lack a well-accepted descriptive term. They are software packages created especially for users. They are comparable in difficulty to BASIC. Yet they are not true general-purpose languages, since they are oriented to specific tasks. Even so, they are very much like general-purpose languages, so I shall call them user-oriented languages.

No matter what they are called, they are among the most valuable resources for users. Here are some descriptions:

AUTHORING LANGUAGES -- PILOT is the most popular authoring language. The term authoring, unfortunately, has little to do with traditional authorship. It has evolved into a term for the creation of educational and tutorial software. A better term might be "teaching languages." Nonetheless, PILOT and its relatives allow the instructor to create question-and-answer programs, keep track of the student's score(s), supply background material and ask separate questions depending upon the "mainline" questions missed, etc. While authoring languages are the only languages designed specifically for teachers or trainers, this does not mean that they are always the best choice for an educational goal--BASIC is still a viable alternative, as is a commercially-written software package.

Most teachers need only three skills to meet the vast majority of educational computing needs: BASIC, PILOT and the ability to properly evaluate commercially-produced software packages.

SPREADSHEET PROGRAMS -- Of most interest to business, math and science teachers, these languages (or software packages) allow the user to arrange numeric data in rows and columns. Changing just one figure causes all figures to be re-calculated automatically. Simple or complex equations can be used to define the relationship between rows and/or columns. Files of data can be saved for later comparisons and statistical manipulation.

The most popular spreadsheet programs are VISICALC, SUPERCALC and MULTIPLAN. It is said by many marketing experts that computer sales were greatly stimulated by the existence of these programs. Users were so impressed with the software that they bought computers solely because they ran spreadsheet programs.

DATABASE PROGRAMS -- Along with all of the other problems that exist with terminology, we must now confront the term "database." The software package/languages called "database packages" in the microcomputer world are not full-featured database systems as used by large computer centers. For microcomputers (of most interest to educators), there are two types: personal filing systems, and database programs. The personal filing system (example: PFS for APPLE) allow the storage and retrieval of simple but orderly data (imagine a 3x5 card file with notes on each card). The database programs such as DBaseII allow the creation of "forms" (much like paper forms) in which data can be stored and retrieved, along with powerful and flexible manipulation commands. Such programs are usually not useful for tutorial purposes, but have many administrative applications (budgeting, inventory records, enrollment figures).

LOGO AND TURTLE GRAPHICS -- New simplified graphics languages are very popular today at the elementary school level. One language is called LOGO, but the general type of graphics programming can be called turtle graphics since there is a simple symbol called a turtle that can be moved around on the screen to form drawings. These languages are not particularly useful today at the secondary/adult levels, but they are a precursor of things to come. It will be very exciting when we can use light pens (allowing drawing directly onto a TV screen) to "merge" drawings with LOGO-like commands. Stay tuned.

What Is The Difference Between Software Packages and Custom Programming?

By now it should be obvious that the computer field lacks standardized terminology. This is not a conspiracy to bedevil the beginner--just the result of an exuberant and creative evolution. For instance, we need terms to describe the new "hybrid" languages, to signify "modifiable by users," and better terms for "database" packages.

Let's review. What most people mean by the term "programming" is the use of general-purpose higher-level programming languages such as BASIC, COBOL and PASCAL. Users seldom write programs in assembly code or machine code. Users can learn BASIC fairly easily, and can take advantage of software packages such as SPREADSHEET PROGRAMS, DATABASES, and AUTHORING; these packages are specifically-designed for users with little computer experience (although they are a bit more difficult than advertisements would suggest!).

Software packages are commercially-prepared programs. Programs such as VISICALC (spreadsheet), DBaseII (database) and WORDSTAR (word processing) are so powerful and useful that we can view them as user-oriented languages in their own right.

There are many types of software packages. Tutorials are used to teach (about any subject, or about computers or still more software packages). Games are strictly for entertainment. Utilities perform useful functions, such as keeping track of students' scores. There are even party-game packages: ELIZA is a crackpot psychoanalyst that diagnoses your id with hysterical results; LOVERS OR STRANGERS asks a series of questions about your love life; and there are now X-rated packages!

There are two important questions about any software package which users must ask: is it written in machine-code or a higher-level language, and can it be modified?

If a software package is written in machine code, it cannot be modified by users (without extreme effort and expense, that is). When we say "modified" we are not referring to those built-in options and functions which exist when the program is used under normal circumstances. For instance, VISICALC has hundreds of techniques for entering, changing and storing data. By contrast, suppose a teacher buys a health-education software package. After a few years of use, the information becomes outdated. If the teacher could modify the program, current material could be substituted for the old material, thus changing the original design of the program slightly. If the program were written in BASIC, it could probably be modified. (Note: several technical methods can be used by software suppliers to make it impossible to "get at" the actual BASIC.

A program must be advertised as "user modifiable" before one can be confident that it is.)

Today, few software packages are user-modifiable. This is an area of great interest to educators, and a source of continuing frustration. Suppose you locate a software package which performs 95% of the functions desired. It would be ideal if you could modify it to accomplish the last 5% of the goals. Unfortunately, this is seldom possible at the present time.

Software suppliers are reluctant to allow user modifications since their software would be easily "pirated." Sadly, educational users (along with most others) are well-known for their pirating behavior. In the future, new pricing schemes and anti-pirating technologies may improve the situation. Professional educational associations should become involved in this issue since it is unlikely that the situation will change without active involvement in licensure matters.

How Can You, As An Educator, Get Involved In Programming?

While there are many avenues for education, I am going to suggest a plan for your education in programming. It is based on the assumption that you do not want to attend a semester-length COBOL or FORTRAN course, and that you do not want to become a data-processing specialist.

STEP ONE -- Computer Concepts. It will benefit you greatly, in the long run, to begin with an orientation to computers. There are really only 3 options--courses, seminars and books or book/software packages. Adult education courses are offered in some areas, but their quality varies widely (for most DP teachers, they are a low priority). A VTAE institution may be able to create a course specifically for teachers. Seminars and in-service presentations are more compact and specialized--but their availability and quality is hard to predict. Here is the only book I can recommend with complete confidence:

INTRODUCTION TO COMPUTERS & DATA PROCESSING
Author: Shelly & Cashman
Publisher: Anaheim Publishing Company
2632 Saturn Street Brea, CA 92621
(714) 993-3700. $18.95

There are a few new book/software tutorial combinations available. If you are interested in this approach, you should try to organize a group of people who use the same computer and research the area. New packages are appearing every day, from both established publishers such as McGraw-Hill, Prentice-Hall, Addison-Weseley and CBS/Holt and from independent, new publishers. Your librarian may be able to suggest methods for locating the material, using one of the new educational software indexes.

STEP TWO -- BASIC. I feel that BASIC remains the best avenue for building confidence and useful skills. It is also the most accessible approach. One cautionary note: learning BASIC without good computer-concepts skills can produce the illusion that one knows a great deal about computers! Under such circumstances, moving beyond simple programs will present obstacles.

There are two ways to learn BASIC--with a course, and by purchasing your own computer or finding access to one. A 10-week adult education course would be more than adequate for most educators. If you purchase a computer, or use one, the quality of the accompanying tutorial BASIC manual becomes critical. The best tutorials (printed) accompany the RADIO SHACK, IBM and APPLE computers. The new APPLE--IIE (enhanced) has a superb tutorial which also has good computer-concepts material.

Examine the written materials for other brands carefully before plunging! The machines which are the best "bargains" in terms of hardware seem to have the worst manuals...

There are many books about BASIC on the market, but their quality varies dramatically. Here is the best BASIC textbook on the market, but it may be too detailed for many users:

INTRODUCTION TO BASIC PROGRAMMING
Author: Shelly & Cashman
Publisher: Anaheim Publishing Company
2632 Saturn Street Brea, CA 92621
(714) 993-3700. $14.95.

It is so much more fun to learn BASIC while using a microcomputer that one should think twice about using a book alone. However, to move beyond very simple BASIC, a good textbook is invaluable.

STEP THREE -- EVALUATE YOUR GOALS. Do you want to concentrate upon evaluation of commercially-written software packages? Do you want to be able to write BASIC and PILOT tutorials on your own? Do you have specialized administrative and word-processing needs? Do you want to buy your own computer? Can you cooperate with a group of colleagues to acquire hardware and/or software?

STEP FOUR -- EXAMINE PILOT. Most teachers will want to examine a PILOT tutorial or manual to determine its value for their goals. In general, PILOT can be learned "on your own" using the manuals provided by the manufacturer, so long as you have adequate computer-concepts preparation. The PILOT user also needs some assistance from a more experienced user in the area of floppy-disk handling and file usage for the specific brand of computer used.

STEP FIVE -- SOFTWARE EVALUATION. Educators need to learn more about software evaluation--not only for their own needs, but for future student tutorials. For instance, a teacher might want to evaluate WORD PROCESSING, SPREADSHEETS and an AUTHORING package for their own purposes (including future preparation of tutorials). The same teacher might also be a part of a committee charged with locating and evaluating tutorial software in a specific subject area.

No matter what the purpose, here are some typical steps in the evaluation process:

a. Gather written material about the software package from the manufacturer and from written reviews in the computer periodicals (many periodicals are now indexed--see librarian).

b. Seek advice of users who have the package, if possible.

c. Try to arrange a live demonstration of the package from a dealer. You might also be able to borrow a review copy from the manufacturer (unlikely if the package is easily copied!).

d. Determine whether your educational association has any information on the package. Check the new educational software evaluation services at the library.

e. After purchase, the software should be tested. If it is tutorial software for student use, it should be field-tested using normal educational-evaluation methods. Comment: standards should be higher for computer-based instruction than for print-based instruction due to the need for detailed operational instructions and the lack of modifiability.

f. If you place the software "into production" in an educational setting, a back-up copy of the software and its documentation should be placed in a secure place (even a vault).

A note on documentation: the accompanying written materials are often as important as the software itself. Also, you may need to produce and test two additional items:

a. Instructions for students about how to load the software, and keyboard usage (for your brand of computer).

b. Student self-scoring sheets (on paper) or other paper-based feedback devices.

Summary

It is hoped that this grand tour of the computer world has been pleasant for the reader. Perhaps computing does not seem so formidible now. The most important point to remember is that the three major programming tools of interest to educators--BASIC, PILOT and software packages--have all been specifically designed to be user-oriented. Whether "user-oriented" means "easy, convenient and understandable" --to you--can only be determined one way: by trying it. Good luck.

```
        AUTHORING SYSTEM- LESSON CREATION MENU

           Please choose from the list below

           1. Create a TEXT screen
           2. Create a QUESTION screen (Multiple Choice)
           3. Create a QUESTION screen (Fill-in)
           4. SAVE the lesson to disk.
           5. Exit to main menu.

           ENTER THE NUMBER OF YOUR CHOICE >
```

Choosing NUMBER 1, the screen would go blank except for an information line and we would be instructed that this is a text screen and that we should TYPE in the text that we wish to have displayed. These instructions will usually occur at the bottom of the screen.

For our example we will do a short tutorial on stamp collecting. Our first text screen will simply be the title of the lesson.

```
                  A SHORT TUTORIAL

                         on

                  Stamp Collecting
```

Having typed in the title and pressing the appropriate key to indicate that we are done with the screen, we would be asked to indicate which screen number this is to be in the lesson. SCREEN #: (we would simply enter 1 indicating this is the first screen). The program would then take us back to the CREATION MENU.

Again we would indicate that we want a text screen and when it appears we would type the following:

```
Stamp collecting is called philately. So a person
who collects stamps is called a philatelist.
There are an estimated 16 million philatelists in the
United States alone.

Stamp collecting, the world's most popular hobby, got
it's start only a year after the introduction of the
postage stamp. And if you think postage stamps have
been around for centuries, think again. The first
appeared in England in 1840.
```

This time we would save SCREEN #: 2 to indicate that this screen should appear after the title screen.

Again returning to the CREATION MENU we are presented with the option list. Let's take option Number 2 and prepare a multiple choice question. A "template" similar to the following would appear. The cursor would be flashing after the colon (:) following the word INSTRUCTIONS.

```
INSTRUCTIONS:


QUES.#      :


A.
B.
C.
D.

ANS:
```

We now would type in the instructions to the student, the question number, the response choices, and the letter of the correct answer as follows. After we type in the instructions we press <ENTER>, the cursor will move to the question number blank and then the question area etc. until we are through entering all the information and again press the control key indicating that we are through with the screen.

We would type in the questions as follows.

```
INSTRUCTIONS: Please choose the best answer from those
given below. Type in the letter of your choice and press
<ENTER>.
QUES.# 1  : What is another name for stamp collecting?


A. lapidary
B. stampography
C. philately
D. effectuation

ANS: C
```

After we have entered the question and the response choices a typical program might now provide us with the opportunity to provide feedback to each specific incorrect answer and a response to the correct answer. For example:
The screen might read-
What is the message if the student takes choice A?

and we would type a response such as: Sorry, Lapidary is concerned with the art of cutting gems.

When we have entered feedback for each answer choice the screen would be saved as SCREEN #: 3.

Returning to the menu we now might choose Option 3 for a fill-in question.

Again we would be provided with a "template" and would fill it in as follows:

```
INSTRUCTIONS: Please answer the following by typing in the
answer and then pressing <ENTER>

QUES. # 2  : In what country was the first postage stamp used?


ANS:< ENGLAND!BRITAIN!GREAT BRITAIN
```

Note: A typical program will allow a number of acceptable answers. Here we will accept ENGLAND, BRITAIN, and GREAT BRITAIN. The symbol -!- is a means used in our sample program to separate answers.

Again we would save the screen by indicating a screen number.This time SCREEN #: 4.

And that's how it is done.

Our program could now be used by the student. When the program is run the title screen would appear and the student would be prompted at the bottom of the screen to <press enter to continue> . When <ENTER> is pressed,screen two (2) would appear, the <ENTER> prompt, then the questions etc. If the student answers incorrectly the feedback would be provided.

At the end of the lesson the student's score might be recorded to the diskette for future reveiw by the instructor.

HOW TO CHOOSE AN AUTHORING SYSTEM:

Many authoring systems contain a number of options not discussed in the previous example . Just what are some of the others and what should we look for in attempting to choose the authoring system that is best for us?

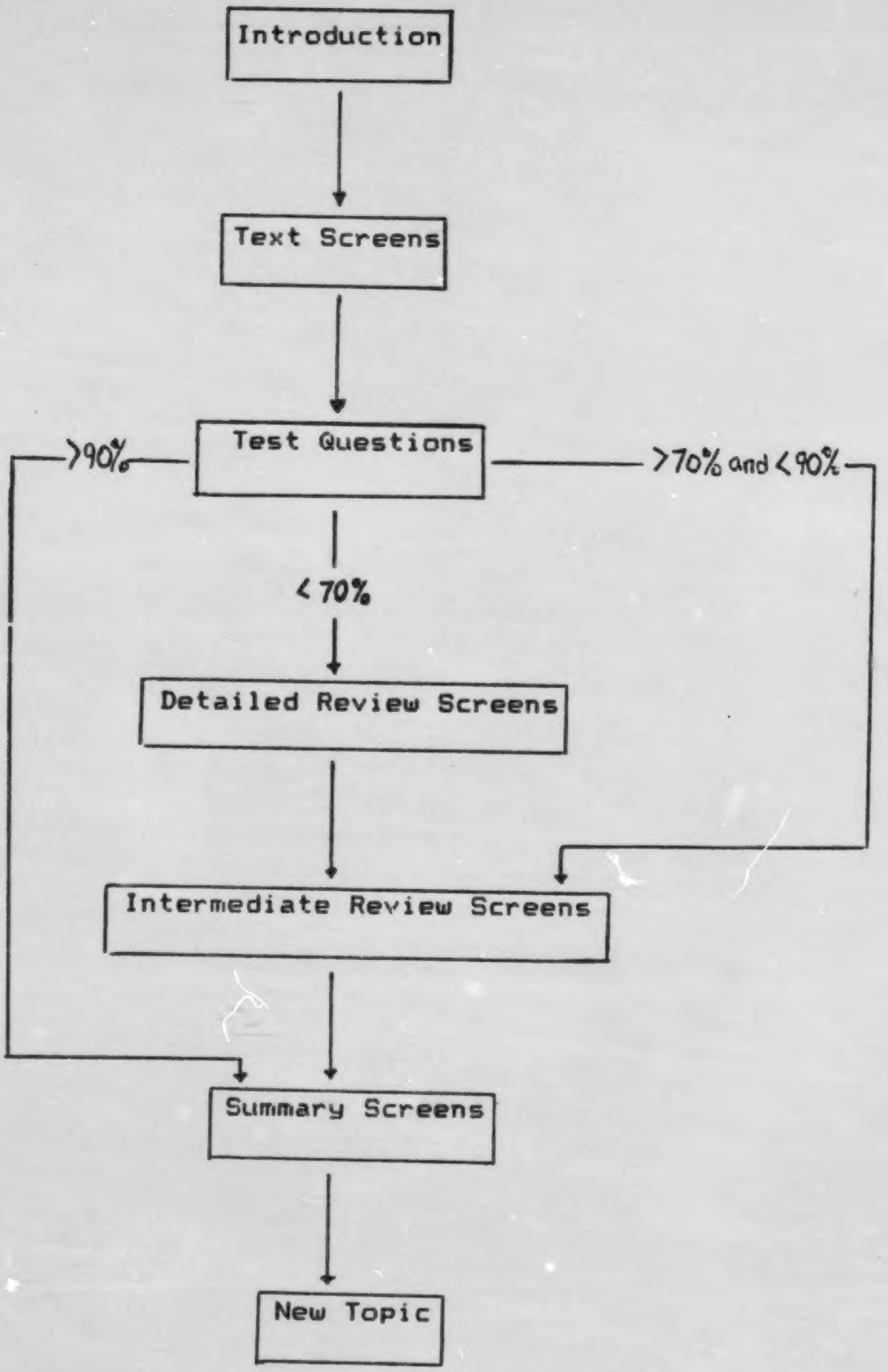
The following is the primary question that should be considered. What software is available for your computer? You will be forced to limit your choices to your brand of computer and its specific capabilities. For example: Does the software require two disks drives? What memory is required to run the program?

Assuming you have a number of authoring software systems available for your computer, you must now consider the next question. Just what type of lessons do you want to author? Once you have made that decision the following the features and capabilities of the software should be considered.

1. Does lesson sequence structure allow branching?

Although you may wish to present the same lesson in the same straight-line sequence to all students on some occassions, the real power of lessons delivered by microcomputer is that the flow and sequence of the material can be individualized. The student may be provided with as little or as much of the lesson as deemed appropriate by the computer based on how the student answers specific questions and the standards you as the author have set for specific branching. Some systems allow very complicated branching based on the percentage of questions a student has answered correctly in a series of questions based on the previous text material. An example of an actual flowchart from such an authoring system is given on the next page.

Text material is presented. A test is given. Based on the test results the student may skip all review material or be given a portion of it as determined by the percentage of correct answers. The percentages are set by the author during the creation of the program.


Introduction
Text Screens
Test Questions
>90%
>70% and <90%
<70%
Detailed Review Screens
Intermediate Review Screens
Summary Screens
New Topic

Another very important sequencing question. Does the program allow the student to review a previous screen with just a single key input? In learning by means of computer text as well as learning by means of paper based text materials the student often finds the need to review a previous page. A good program will allow the student this opportunity.

Does the program allow temporary exit to hint, help, and glossary screens during execution of tutorials? Some systems have excellent user control of flow and sequence in these areas.

Although some authoring systems allow more specific sequence control and branching capabilities than others, it is still important to remember that in all cases your program design will be limited to what the system offers.

2. What question formats are allowed?

Authoring system question formats range from single format programs such as "templated" multiple choice to systems that allow almost any type of questions on "nontemplated" text screens. The software package you choose will depend on the type and variety of the questions you will incoporate in your program.

If you are using completion items you must also consider the fact that there may be more than one answer for a particular question. In such case you should compare the various systems in terms of their answer matching options. Some systems require a perfect match. Some systems scan the student response for short sequence of matching letters thereby allowing for minor errors in spelling. Some systems allow only a single response to be matched, while others allow a list of possible responses to be checked by the letter scan or perfect match.

3. Do you have control over the number of trys a student is given to answer a question, or the length of time a question appears on the screen?

Some systems allow the student an infinite number of chances to answer a specific question while other systems allow the author to limit the trys to as few as a single attempt. Along with this feature some systems "mark" the question wrong after the first attempt while others may be "programmed" by the author to allow "relaxed scoring" with credit still given on the second and third attempt.

Some systems also allow the author to control the length of time a question appears on the screen. This may be a very important feature in testing skill areas where an immediate and accurate response to particular questions is important.

4. What graphic capabilites will you need?

Not all authoring tools take advantage of the graphic capabilities of the computer for which they were written. And even if they do, the ease of programming graphics ranges from easy to very complex to produce virtually the same type of graphics display. If you need graphics, check very carefully the ease of creating graphics screens and whether or not text and graphics can easily be displayed on the same screen.

5. What type of record keeping does the system do?

The amount of information stored by various systems ranges from as simple to the student name, name of lesson, and score to as complex as the name of student, name of lesson, date, time of day, time spent on the lesson, score, which questions were answered incorrectly and the answers each student gave to each question. Some systems are complex enough to actually manage the student's progress through a series of lessons by keeping track of the previous level of achievement and slotting the student into the lesson most appropriate to their present skill level.

SOME AUTHORING SYSTEMS CURRENTLY AVAILABLE:

For the Apple II+:

A.I.D.S: Lesson Authoring, Branching
Skill Corp Software, Inc.
1711 McGaw Avenue
Irvine, CA 92714

Block Author System : Lesson Authoring, No Branching
California School for the Deaf
Computer Lab
39350 Galludet Drive
Fremont, CA 94538

Courseware Development System I: Lesson Authoring: No Branching
Bell & Howell Company
7100 N. McCormick Rd.
Chicago, IL 60645

OMNITEST: Test Authoring, No Branching
Educational Computing Systems
136 Fairbanks Rd
Oak Ridge, TN 37830

SOFCRATES: Lesson Authoring, Branching
Simpac Educational Systems
Suite 11-C
1105 N. Main St.
Gainesville, FL 32601

ZES Authoring System: Lesson Authoring, Branching
Avant Garde Creations
P.O. Box 30160
Eugene, Oregon 97403

For the Apple and IBM-PC:

The Author: Lesson Authoring, Branching
Pheonix Performance Systems, Inc.
324 South Main, Suite #1
Stillwater, MN 55082

For the TRS-80 Model I and III

Author I: Lesson Authoring, Branching
Radio Shack
Education Division
400 Atrium , 1 Tandy Ctr.
Forth Worth, TX 76102

CAIware 3-D: Lesson Authoring, Branching
Fireside Computing
5843 Montgomery Road
Elkridge, Maryland 21227

Quick Quiz: Test Authoring, No Branching
Radio Shack
Education Division
400 atrium, 1 Tandy Ctr.
Forth Worth, TX 76102

MICROCOMPUTERS AND SPECIAL EDUCATION STUDENTS

INTRODUCTION

The Microcomputer Potential

Microcomputers can serve a multitude of needs in the education of handicapped students. They can assist students in acquiring basic skills and information and in accomplishing the ordinary tasks required in a job situation. They can provide individualized instruction and increase the motivation level and self-esteem of discouraged learners. Further, as they use microcomputers to accomplish specific tasks in school, students develop the computer literacy skills so critical in our technologically-oriented society. Finally, microcomputers can help classroom teachers with management, recordkeeping, and reporting tasks and enable them to have more time to instruct and assist students. These examples are not intended to be exhaustive, but merely to provide a starting point for vocational educators who work with special education students.

Microcomputer Software

Software determines how a microcomputer will be used and how effective that use will be. Software can be categorized according to general types of applications. Although these categories are not exclusive, they provide a useful framework for discussing potential microcomputer applications.

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Computer-Assisted Instruction (CAI) or courseware refers to software designed to teach or instruct particular skills such as mathematics, spelling, or typing. CAI can present basic skills or specific vocational skills to students. The instructional mode may be tutorial, drill-and-practice, or simulation.

Another type of software is solution-oriented. The program helps the user accomplish a task more efficiently such as to produce a document, store and process information, develop an individualized education program (IEP), or even create a CAI lesson. Software in this group includes word processing, database management systems, electronic spreadsheets, and courseware authoring systems. Computer managed instruction (CMI) software such as teacher grade books, curriculum development systems, and other class management programs are also included.

A third category of software important to vocational educators and handicapped students are those programs which convert a microcomputer to a brailler or a communications tool. This software may be considered an assistive device or prosthesis because it specifically helps handicapped students overcome the disabling effects of a sensory, mental, or motor impairment.

One software program can serve a variety of needs. For example, although word processing training can offer students a useful vocational skill, this software can also help students develop language skills, acquire a useful life skill and communication tool, and concurrently develop computer literacy skills.

Microcomputers in Vocational Education

Many microcomputer applications hold promise in the education of handicapped children. The specific topics to be discussed in this chapter are computer literacy, LOGO, basic skills, word processing, vocational skills, assistive devices, and classroom management. Each of these applications can be extended to vocational education programs serving special needs students.

COMPUTER LITERACY

Because microcomputers can help mildly, severely and profoundly handicapped students perform many learning and work-related tasks that previously may have been impossible or at least very difficult, computer skills can improve the overall quality of life of the handicapped. Helping students become computer literate is an essential microcomputer application for the vocational education classroom. It is therefore crucial to understand the dimensions of the term "computer literacy."

Introducing Microcomputers

The first step in acquiring computer literacy is becoming comfortable at the terminal, knowing how to turn the computer on and off, using the keyboard, and loading and removing programs on diskette or cassette tape. Students can learn to copy programs, use a few BASIC commands such as LOAD, RUN, and CATALOG, and operate a printer or modem. Initial training should include a few games and other easy-to-use applications software. Each microcomputer comes with a manual which explains more than enough to get started. Many third party producers have developed print, audiocassette, diskette, and videocassette materials designed to acquaint students and adults with the basics of operating a computer. One example is How to Operate the Apple II Plus: An Audio Cassette Mini-Course (Note 1), a set of cassettes which walks the beginner through the fundamentals.

Perhaps the most important component of the initial literacy training is information about what computers can and cannot do. Students and teachers both may have misconceptions that need to be corrected as well as horizons to expand. With a little computer experience, students will be able to use a microcomputer for basic skill development. CAI programs vary widely in quality and ease of use; however, in general, they do not require students to know the BASIC programming language.

Applications Software

For most people in the work force, computer literacy means being able to use specific software programs such as word processing, database management, an electronic spreadsheet, an accounting program, an inventory program, etc. To use these programs, students will require more than training on the operation of a computer; they must have fundamental skills and knowledge of the specific area in which they will use the program. In a job situation, computer literacy means entering, retrieving, and interpreting data correctly. Word processing workers must know how to type, spell, edit, and proofread in addition to being able to use a particular computer and software.

Programming a Computer

Another aspect of computer literacy is being able to control the computer by learning its language--learning to write the instructions that the computer follows. Because BASIC is the language built into microcomputers, many students begin by learning that language. Students also can use microcomputers to learn other common programming languages such as FORTRAN, COBOL, Pascal, and LOGO. Although learning enough about BASIC to write some simple programs is rather easy, becoming an expert programmer takes effort, motivation, and time.

Benefits from Programming

Learning how to program a computer at an expert level clearly provides an individual with a vocational skill. Other benefits, however, can be derived, such as developing problem solving, logical thinking, and mathematics skills. The LOGO language, in particular, has been widely recommended for use with handicapped students.

LOGO: A SPECIAL COMPUTER LANGUAGE

LOGO, a computer language designed especially for education by Seymour Papert and his associates at the Massachusetts Insitutute of Technology (MIT), is structured so that even preschool children can use a computer to learn mathematics, programming, and problem solving. LOGO is also a complex, powerful programming tool with applications for highly skilled programmers (Abelson, 1982; Papert, 1981).

An important difference between LOGO and most other languages is that students can define commands and create their own language. They "teach" the LOGO turtle (a small triangle on the screen), by providing it with simple or complex instructions. The turtle will move any given number of spaces on the screen and will turn at any angle. Students tell the turtle the moves necessary to draw a square, a house, or other object. Then they can command the turtle to "SQUARE" or "HOUSE" and the turtle obeys. Complex drawings can be developed through a process of estimation, experience, and revision. Using LOGO, students determine the problem to be solved, make choices, and build on what they learn. This aspect of LOGO is called turtle graphics; there are also list processing commands that can open a realm of interactive language arts programs.

The Terrapin Turtle Robot

Because using the keyboard is difficult or impossible for severely handicapped students, other methods of using LOGO such as the Terrapin Turtle Robot have been developed. The turtle robot looks like a clear, inverted bowl on two wheels. It is attached to a long cord going back to the computer. The turtle robot draws shapes on large pieces of paper on the floor. To send LOGO commands to the turtle, individuals push large buttons or use other easy to manipulate devices.

LOGO and Handicapped Children

The MIT LOGO group has worked with many physically disabled, autistic, emotionally disturbed, and dyslexic children and has developed case studies demonstrating their improvement in academic and social development (Weir, Russell, & Valente, 1982). Teachers also have found that LOGO helps slow learners gain self-confidence in their approach to problem-solving (Muller, 1982b). At the Cotting School for Handicapped Children in Boston, severely and profoundly handicapped students have been helped to learn writing, mathematics, and programming using LOGO (More on Logo, 1982). The success of LOGO in teaching programming and developing other basic and vocational skills has been widely reported in the literature (D'Angelo, 1982; Euchner, 1982; Grady, 1982; Hancock, 1983; Watt, D., 1982; Watt, M., 1982).

LOGO is available on diskette for Apple computers from Krell Software, Terrapin, Inc., and Apple Computer (Note 2) and for the TI 99/4 from Texas Instruments (Note 3). Reviews of these versions of LOGO have recently appeared in a number of periodicals (Adams, 1982; Muller, 1982a; Peterson, 1983).

TEACHING BASIC SKILLS WITH MICROCOMPUTERS

Microcomputer courseware (CAI) can be an effective tool for teaching or drilling the basic skills required in a vocational classroom. Although mathematics, reading, and language arts packages are most abundant, teachers will also find useful CAI materials to teach typing, measurement, and other specific skills required in various occupations. Appendix A lists several producers of courseware that special education teachers have found useful. Courseware evaluation guidelines and assistance in locating materials are available from MicroSIFT and EPIE (Note 4).

Research Findings

In a comprehensive review of the research literature, evidence indicated that students learn more, retain more, or learn the same amount faster using computers; further, they enjoyed learning more (Bracey, 1982). Reports show that microcomputers have been used successfully with students with many types of handicaps in a variety of situations. Educationally handicapped students, for example, improved their ability to decode language (Spring & Perry, 1981-1982). In another study, the spelling problems of learning-handicapped students were remedied (Hasselbring, 1982). Profoundly mentally retarded children improved their ability to use language and acquired positive social behavior in a program involving word processing software and a microcomputer (Thomas, 1981). In another study, hyperactive children were able to work longer at a task with the help of specially designed microcomputer software (Kleiman, Humphrey, & Lindsey, 1981).

WORD PROCESSING

In business, small and large computer systems have been used for word processing for many years. Usually, the computer is a "dedicated system," which means that the computer was designed specifically for word processing and probably is not used for any other applications. Word processing software also is available for the all-purpose microcomputer such as the Apple, Atari, TRS-80, PET, and TI 99/4. These word processing programs range from easy-to-use, inexpensive, and unsophisticated to powerful, complex, and costly. Between those two extremes are many programs from which to choose. A comprehensive review of word processing programs for microcomputers and glossary of terms appeared in the December issue of Interface Age (Heinz, 1982).

Word processing skills are clearly important in vocational education; however, a microcomputer and a word processing program can also make life easier for anyone, including teachers. Any document (tests, quizzes, letters, reports, work sheets) can be typed, edited, saved for future use, and printed in single or multiple copies. Each worksheet or test can be individualized for a student. Instead of acquiring a huge file of materials, teachers can maintain a file of diskettes in a small box or notebook.

Teaching Language with Word Processing

Word processing software and microcomputers also have been used to teach students language and composition skills. At the National Technical Institute for the Deaf, for example, a program titled Magic Window (Note 5) was used successfully with hearing impaired students (Miller, 1982). Other educators have reported improvement with students from elementary to high school and have pointed out how the ease of revising with word processing software motivates students to produce error-free compositions (Beechfold, 1982; Dauite, 1982).

THE MICROCOMPUTER AS AN ASSISTIVE DEVICE

In addition to courseware and solution-oriented software packages, microcomputers can be used in a variety of ways as assistive devices or communication tools by handicapped individuals. For example, brailler/text editors allow teachers of blind students to quickly produce braille copies of any printed materials (McConnell, 1982; Note 6). Microcomputers with special software and speech synthesizers have helped many non-verbal handicapped people to communicate (Baker, 1982; Demasco & Foulds, 1982). For additional information or specific assistance in locating adaptive software or hardware, educators should contact the Trace Center (Note 7) or the Prentke-Romich Company (Note 8).

Other Assistance for Students and Teachers

Special assistive software also has been designed to help teachers of handicapped students. For example, a program was designed to aid teachers in teaching lip-reading to hearing impaired students (Hight, 1982). Other courseware, which has been designed for general populations, has been found to be helpful for students with learning disabilities, and emotional or speech disorders. A major concern of special educators always has been the difficulty in getting and holding the attention of these students. A microcomputer used in day-to-day instruction can greatly increase these students' attention spans. Large color graphics are attention-getters and are beneficial to students with impaired vision. Programs that provide instant feedback and that personalize the lesson by naming the student also help to sustain attention. The unlimited amount of repetition that computerized lessons can offer is yet another advantage (Sicoli, 1982).

ASSISTANCE FOR THE TEACHER

When a school purchases software, at least some of the money should be spent on programs to help the teacher with class management, recordkeeping, reporting, and instructional development. With microcomputers, teachers can quickly take care of chores that were previously time-consuming. In many cases, a microcomputer allows a teacher to do things that may have been left undone due to lack of time. For example, programs that rapidly analyze the readability of text using several formulas such as Spache, Dale-Chall, and others are available. Software can create word search and crossword puzzles from lists of words typed into the computer. Grade-book programs can store records for several classes, alphabetize lists, compute statistics, and print reports. Computerized systems such as the Super-Planner from Learning Tools, Inc. have been designed for the needs of special educators in individualized instructional planning and reporting (Note 9). In addition, word processing programs, career guidance systems, and many other solution-oriented software packages can make teaching easier as well as more efficient and effective.

SUMMARY

The vocational applications of microcomputers for special education students presented in this paper have barely scratched the surface. An analysis report of applications of microcomputers in vocational education and an annotated listing of periodicals containing items of interest to vocational educators who use microcomputers are available from the National Center for Research in Vocational Education (Note 10).

To review, some of the major uses of microcomputers which can be explored by vocational educators are:

- To promote technological and computer literacy
- To improve basic skills

- To develop skills for daily living
- To develop vocational skills
- To assist teachers in the classroom.

REFERENCE NOTES

1. How to operate the Apple II Plus. FlipTrack Training Tapes, Box 711, Glen Ellyn, IL 60137. Telephone 312/790-1117.

2. Krell LOGO. Krell Software Corporation, 1320 Stony Brook Road, Stony Brook, NY 11790. Telephone 516/751-5319 ($149.95). Terrapin LOGO, MIT. Terrapin, Inc., 380C Green Street, Cambridge, MA 02139 ($149.95). Apple LOGO. Apple Computer Company, 10260 Brandley Drive, Cupertino, CA 95014 ($175.00).

3. TI LOGO. Texas Instruments, Inc., PO Box 53, Lubbock, TX 79408 ($129.95).

4. MicroSIFT. Northwest Regional Educational Laboratory, 300 SW Sixth Avenue, Portland, OR 97204. Telephone 503/248-6800. EPIE Institute, PO Box 620, Stony Brook, NY 11790. Telephone 516/246-8664.

5. Magic Window. Artsci, Inc., 10432 Burbank Boulevard, N. Hollywood, CA 91601 ($100.00; for Apple II and II Plus, DOS 3.3.).

6. Raised Dot Computing, 310 South 7th Street, Lewisburg, PA 17837. Telephone 717/523-6739. (Brailler/Text editor for Apple II; $250.00.)

7. Trace Research and Development Center, University of Wisconsin-Madison, 1500 Highland Avenue, Madison, WI 53706. Telephone 608/262-6966.

8. Prentke Romich Company, 613 Township Road, Shreve, OH 44676. Telephone 216/567-2906.

9. SuperPlanner. Learning Tools Inc., 686 Massachusetts Avenue, Cambridge, MA 02139. Telephone 216/864-8086.

10. National Center for Research in Vocational Education, 1960 Kenny Road, Columbus, OH 43210. Telephone 800/833-4707.

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APPENDIX A

SELECTED SOURCES OF COURSEWARE SUITABLE FOR SPECIAL EDUCATION STUDENTS

BARTLEY SOFTWARE 3268 Coach Lane #2A Kentwood, MI 49508	Courseware that teaches letter recognition, word families, arithmetic and verbal skills, and clock-telling time with large character screen displays.
CALIFORNIA SCHOOL FOR THE DEAF 39350 Gallaudet Drive Fremont, CA 94538 Telephone: 415/794-3687	Public domain courseware developed by teams of teachers and programmers for Apple II computers; also, BLOCKS, a courseware development system for teachers.
DEVELOPMENTAL LEARNING MATERIALS One Elm Park PO Box 4000 Allen, TX 75002 Telephone: 800/527-4747	Producers of the Arcademic Skill Builders series for Apple computers, mathematics drills in game format designed for keyboard or paddle input. Programs can be set at very easy to challenging levels.
EDUCATIONAL ACTIVITIES, INC. PO Box 392 Freeport, NY 11520 Telephone: 800/645-3739	Courseware for major microcomputer systems in most academic areas. A set of math materials designed by a special education teacher for slow learners and learning disabled students is available.
EDUCATIONAL RESEARCH, INC. 44 N. Last Chance Gulch Helena, MT 58601 Telephone: 406/443-3600	Producers of educational software for handicapped children including topics such as concept formation and others.
EDU-WARE SERVICES, INC. PO Box 22222 Agoura, CA 91301 Telephone: 213/706-0661	Producers of mathematics, algebra, visual discrimination, perception, and other programs for Apple and Atari microcomputers.
IDEATECH COMPANY Box 62451 Sunnyvale, CA 94088 Telephone: 408/985-7591	Educational software for learning-disabled and mentally handicapped students for an Apple computer. Titles include: Basic Electricity, Color Guess, Mathpack-1, and Languagepack-1.
MCE, INTERPRETIVE EDUCATION, INC. Mall Plaza, Suite 250 1575 S. Kalamazoo, MI 49007 Telephone: 616/345-8681	Producers of vocational education and career development software for apple computers.
MINNESOTA EDUCATIONAL COMPUTING CONSORTIUM (MECC) 2520 Broadway Drive Saint Paul, MN 55113 Telephone: 612/376-1105	Educator-developed courseware for Apple and Atari microcomputers; most subject and age groups; computer literacy, vocational education, and class management software.
SOFTSWAP/CUE San Mateo County Office of Education 333 Main Street Redwood city, CA 94063 Telephone: 415/363-5472	Public domain courseware developed by educators for major microcomputer systems in many subject areas and skill levels.

MICROCOMPUTERS FOR THE HANDICAPPED

by

Sam L. Jenkins

If anyone is going to benefit from computer technology, the handicapped will. Indeed, computer capabilities which are merely interesting or unusual to the general public may be esstential for the handicapped. A computer which will scan a page in a book and pronounce each word is a mere curiosity unless you are blind. The potential for using small microcomputers or home computers for the handicapped is just beginning to be realized. With the dramatic drop in prices of the computers and their concurrent increase in capability, sophisticated solutions are possible for some of the chronic problems faced by handicapped individuals.

In the general hubbub of computerization in education, most people fit between two polar views. On the advocate side of computerization in education is the individual who supports computers because they like gadgets and personally enjoy the break in the routine that new technology provides. The closets of institutions are full of interesting but ineffective audiovisual equipment which have had a brief period of popularity. At the other end of the scale is the individual who has trouble accepting even electric typewriters or anything else that smacks of new technology. Both these extremes represent danger to the intelligent implementation of computers for special education students. More specifically, in the area of special needs students, there is a risk of ignoring the computer technology until a prescriptive label is placed on the computers and software. Some will wait until the equipment and the software comes with the appropriate LD or MH label to insure that the programs are "safe" to use. Others may wish to use any off-the-shelf programs without proper consideration given to the special learning problems of the handicapped student. Of course, intelligent moderation is required to implement computer based education. But, you may ask, why is the computer any more effective than other more tried and tested methods of instruction? What can a computer do better?

Your answer depends upon which of the above positions are responding to the question. There is no simple, totally verifiable answer to these questions.

But a most persuasive argument can be made for the basic concept of INTERACTIVE program techniques. Imagine you have a filmstrip and aduio tape which explains the basic parts of a bicycle. The student can only watch the film as it advances automatically through the preset sequence. The student or a teacher may manually press the pause or stop button on the filmstrip projector to ask questions and stimulate discussion, but otherwise, the student progresses through the exercise in a linear fashion. Contrast that with the computer assisted instruction technique. The student can observe diagrams and charts on the screen or a work book. Questions about the material can be presented upon the video screen. The computer may even "speak" and ask the student questions verbally. The computer can evaluate the student's responses as he presses keys, points a light pen to the correct place on the screen, guides joysticks, etc. If the response is evaluated as "correct" the computer can continue with the next segment of information. If however, an error is detected, the computer program can branch to remedial instruction or helpful prompts to help clear up the missunderstanding. This is an INTERACTIVE program technique where the student actually influences the lesson content and order of presentation. The student can control the pace of the lesson, and to a certain extent, the content. Feedback can be immediate. Learning can be reinforced instantly, and of course the computer has "infinite patience." Notice that the effectiveness of the computer still rests upon the appropriateness and accuracy of the lesson content. Instructional design is critical. The computer must not become a mere gimmick. If the computer is used merely as an electronic page turner it will prove to be an expensive gimmick which has no distinct advantage over the traditional tools of education. It is for this reason that special education professionals from the schools, sheltered workshops, professional associations, and parents of the special child, must be involved the the development of software for the handicapped.

Public Law 94-142 sets up certain requirements for the education of handicapped youngsters. The most dramatic requirement is that the handicapped child be educated in the "least restrictive environment." This means that wherever possible the physical or mentally handicapped student should be educated in the same location as "normal" peers. Due to the legislative requirements the schools have attempted to locate and utilize all the assistance available to overcome the physical and curricula barriers to mainstreaming of the handicapped.

Rehabilitation agencies and Centers providing services for the Developmentally Disabled are attempting to provide the maximum training possible so that handicapped citizens may achieve a degree of independence. In some cases, vocational placement is the goal while in others, improved functioning in an institutional or home setting is the most that could be achieved.

Individuals who cannot leave their home due to the severity of their disabilities often benefit from aids and appliances which can help them function independently or with minimal care. Often, a handicapped person who would otherwise be unemployable in a competitive job can work effectively if appropriate modification is made to the work station.

Employers, educators, parents, and the handicapped can all benefit from the powerful yet low cost microcomputer technology available today. The ways that microcomputers can be used in the environments mentioned above include: 1) Sensory, motor control, and communications compensation, 2) Environmental control, and 3) Computer Assisted Instruction.

Compensation may be in the area of sensory deficits (visually or hearing impaired), communication problems, or psychomotor problems. Divices to help the sensory impaired e.g., inner ear implants, hearing aides, Kurzweil Reading machines, laser and sonar canes, have received the most notice but recently microcomputers have been used to stimulate the muscles of paralyzed patients to achieve microcomputer controlled walking. Further out on the research and development frontier, work is proceeding on Visual Cortex implants which will permit a blind patient to recognize visual patterns developed by sensors implanted directly into the brain. Communications compensation focuses on overcoming deficits due to the inability to speak. Speech synthesizers and speech recognition units can provide communications channels for these individuals.

Environmental control and management tasks range from mundane word processing for written communication to more exotic remotely accuated switching of lights, appliances, and telephones. Many handicapped, homebound individuals have achieved independence by automating various ordinary household tasks such as locking and unlocking doors, adjusting the heat or air conditioning, using the stove or other appliances. In these appliances the microcomputer can be considered a prosthesis replacing impaired or deficient human abilities.

It is in the area of Computer Assisted Instruction (CAI) and Computer Managed Instruction (CMI) that the low cost microcomputer is finding dramatic application. The education system of the United States from pre-school to post graduate levels is being challenged as never before. A crisis is developing with respect to appropriate use of the computer. Some critics claim that the computer will widen the gap between the poor and well-to-do neighborhoods while others prognosticate the eminent demise of the computer and a return to the good old days! Most educators recognize that our society is making a change into a techno-informational based economy and the computer must be recognized as a tool in that society. Editorilizing aside, the computer can be used to provide instructional material in the following formats:

1) Drill and practice where previously learned information is rehearsed or practiced to obtain mastery.
2) Tutoring (or tutorial) where new material is learned in small increments appropriate to the learning speed and style of the learner.
3) Simulations where a system is modeled and the student effects the model and its outcomes by inputing information or modifying the existing structure of the model.
4) Problem solving where the student is required to interact with a situation which leads them through the process of solving a problem.
5) Gaming where an element of competition is introduced between the student and the computer program. This is usually done in a game like sequence where the competition is fun and stimulating

The most common form of CAI has been Drill and Practice because it is the least complicated to design and program. As microcomputers increase internal memory sizes, larger and more complicated programs are possible. New color graphics and speech capabilities of microcomputers further improve the power and richness of programs. The general advantages of CAI over traditional instructional methods are INDIVIDUALIZATION of lesson content and presentation speed. Each student may receive a "custom" designed lesson based on the computer's analysis of his response rate and quality. By analysing the student's answers the computer program may branch to remedial or advanced material. A cleverly written computer program can be MOTIVATIONAL and interesting. The program can present colorful animated graphics and produce speech so that the student's attention is focused on relevant cues and distractions are minimized. The student can quickly experience success and reinforcement from the program. (S)he can control his/her own learning environment to a certain extent. This sense of control over one's learning can be a powerful motivator. Immediate reinforcement for correct responses and gentle corrections for mistakes give the learner confidence as he progresses through the lesson segments. The student need not suffer the embarrassment of failure before teachers and friends. For the handicapped learner this is doubley important.

Computer Managed Instruction (CMI) provides effective management of lesson assignment, evaluation, and prescriptive instruction. A student's progress can be documented with accurate record keeping. Individual education plans can be prescribed and documented by the teacher. This is extremely important in today's crowded classrooms where the handicapped individual may have to vie for attention.

Some problems exist in effective use of microcomputers. In general, there is a lack of awareness of the availability of computer hardware and software. On the one hand, some may believe that software programs must be specifically designed for a particular handicap before it can be useful. The person holding this view will overlook a large body of software which can easily be adapted for use by and for the handicapped. On the other hand, special education students often do need specially designed software. The author has found that what is inadequate in a software package is usually not due to special needs of the handicapped but is due to poor educational design in general. The most glaring example of this is the program which purports to teach the ABC's but requires the student to recognize complete words and sentences in order to use the program. Such design flaws in software disqualify it for use by normal as well as handicapped learners. In the January 1983 issue of the EDUCATION DEALER magazine, an article written to encourage dealers to inventory and sell computer software for special education, could only find 13 companies producing computer software designed or adaptable for the special education market. (See references for this list). Another important problem is the need for training America's teachers and rehabilitation professionals in computer concepts and techniques. The average professional is struggling to keep up with a miasma of paper work and administrative demands as well as crowded classrooms. Spending the time and effort to learn a new skill in computing is often more than one can face. The computer has introduced unique demands on professional time and skill. Whereas in the past the professional could develop a functional skill with a new teaching devise (e.g., a filmstrip projector) merely be reading the manual and finding out how to turn it on and insert the media material, mastery of the computer as a teaching tool demands a broad understanding of the history and terminology of computers, programming languages and operating systems. Help may be around the corner as computers grow more "user friendly" and less "techno-babble" is used.

The problem of awareness is a serious one. Those unfamiliar with the capabilities of the microcomputer often have little or no understanding of the computer's features and limitations. The author frequently demonstrates educational software which uses animated color graphics and synthesized speech. During these demonstrations, it is common for someone who has just observed animated ducks on the computer monitor to ask "can it do turtles?" This question suggests that the questioner mistook the programmers creative imagination for something built into the computer. They apparently think that the computer can automatically create ducks. Once the beginner is introduced to the actual process of creating such animations they quickly realize that the answer to "can it do turtles" is answered, "yes, if you can program it to turn dots on off on the minitor to look like a turtle." Another way of describing this confusion is analogous to a foreign language student asking of his French Professor, "can the French language describe a sunset?" The point is that the computer and the languages used to program it are only as powerful as the person using the machine to create the educational material.

You may realize that some computers will have special features which make them more suitable for certain types of programming than others. The second part of gaining useful awareness about computers is being able to evaluate different brands for their unique features so that appropriate equipment is selected. The following is a partial list of the features which are advantageous to have for computer assisted instruction for the handicapped.

1) Color graphics capabilities. Color graphics can be extremely effective in presenting information visually to the student. For those with poor verbal skills, the graph, chart, or color animation may illustrate a concept. One picture is indeed worth many words. It is extremely important that the graphics be simple to use so that the novice programmer can easily work with the computer and use the graphics capabilities without having to develop advanced programming skills. The computer should have the ability to present graphics and words on the same screen at the same time. Some popular computers cannot do this without special programming techniques. The graphics resolution must be sufficiently detailed to present clearly identifiable objects. Just a year ago programmers were attempting to represent animals, etc. with "stick" drawings. Today this would not pass. Today's modern microcomputer and software can generate drawings of striking detail. For lively, interesting, animations the capacity to generate graphic characters called Sprites is important. Sprites are graphic characters which can be made to look like any character on the keyboard or can be defined by the programmer to look like anything desired. These objects can be manipulated by the computer so they float around on the screen, collide, change shape, emit sound, and generally create high quality graphics which are difficult to do without sprites.

2) Sound generation for the creation of music. Sound can be used to generate beeps for simple feedback to the student. Such audio feedback can be used to indicate when a key has been pressed correctly, etc. More importantly, sound generators in the computer can be programmed to play musical scores providing a striking and interesting auditory reward for the student. The sound capabilities of the computer should be easily programmed from BASIC and not require any special programming skills.

3) Speech synthesizer. Synthesized speech output may be required to substitute for printed instructions for those who cannot read either due to visual limitations for intellectual impairment. If the computer can be programmed to talk to the student it seems more personal and easier to use.

Speech input to the computer can substitute for entering information from the keyboard helping those who may be physically unable to press the keys.

4) Large character set for video monitor display. Educational programs benefit not only from colorful animations but also require large easy to read printed characters. Many microcomputers can put 80 characters on each line of the video display which is good for data and word processing. It reduces the size of each character, however. It is better to have the capability of generating and displaying characters 2 or 3 inches on a side for educational programming. It is especially advantageous if the character set can be displayed using the Sprite graphics so that every character in the alphabet can be used as a separate (and large) animated character.

5) Easily programmed by the user. Few people are going to learn programming sufficiently well to develop their own educational software. But it is important that someone is available as a resource person to modify software for the special needs group. This may be someone in the educational system who shows a special interest in programming and who can develop the skills necessary for basic program modification. If the computer is easy enough to use and the programming language simple enough to understand, even the non-programmer may be able to learn how to do simple modifications to the program. The ideal situation is to have a computer which is extremely easy to program, yet has a powerful set of BASIC programming commands which can be manipulated to achieve the special effects of integrated animated color graphics, sound, and synthesized speech.

6) Large body of basic skills software which can be adapted to special needs groups.

7) Easy to use keyboard.

8) Special devices for input such as joysticks, lightpen, and graphics tablet.

9) Other features include: Tape recorder or disk drives for data and program storage. The disk drive is faster and more reliable but cost about 10 times as much. A printer for hardcopy of records is also desirable. A simple, low cost, dot matrix printer will be adequate for this purpose.

PUBLICATIONS AND DIRECTORIES

BYTE: THE SMALL SYSTEMS JOURNAL
P.O. Box 328
Hancock, NH 03449
(September 1982 more than a half dozen articles about computers and the disabled.)

THE CATALYST, WESTERN CENTER FOR MICROCOMPUTERS IN SPECIAL EDUCATION, INC.
Suite 275
1259 El Camino Real
Menlo Park, CA 94025
415-326-6997
Bimonthly; $12/yr for individuals, $20/yr for companies and agencies; complimentary copies sent upon request.
Newsletter that covers the spectrum of special ed/microcomputer topics, including software, hardware and pertinent regulations.

CLOSING THE GAP
Route 2, Box 39
Henderson, MN 65044
612-665-6573
Bimonthly; $15/yr, single copies $3.00
Newspaper that provides information about microcomputer programs and devices that help handicapped individuals "close the gap" between themselves and the rest of society.

MICRO MARKETS EXAMINER
Kathy Hurley
Morgan Point Press
P.O. Box 411
Eureka Springs, AR 72632
501-253-8053
Ten Issues/year, $74.00.
Specifically for dealers and software producers, this newsletter includes information about microcomputers and special education in every issue.
Other features: marketing column, Washington report (federal funding, etc.), new peripherals and their impact.

PERSONAL COMPUTERS FOR THE PHYSICALLY DISABLED
A RESOURCE GUIDE
Apple Computer, Inc.
M/S 9H
10260 Bandley Dr.
Cupertino, CA 95014
408-996-1010
Free upon request, this booklet describes microcomputer applications for the handicapped and lists contacts for each program, device, publication or service discussed.

TRACE CENTER INTERNATIONAL SOFTWARE HARDWARE REGISTRY
University of Wisconsin-Madison
$15.00 plus $1.50 for shipping
A comprehensive, descriptive listing of software, hardware and adapters as well as miscellaneous tips and application notes regarding the use of computers with handicapped individuals.

PRODUCERS OF SOFTWARE, DEDICATED HARDWARE AND ADAPTIVE DEVICES

Although many of the following organizations specialize in microcomputer products for the handicapped, others (such as Texas Instruments) are listed because their products are widely used in special education although they were not specifically designed for this field.

BLS, INC.
2503 Fairlee Rd.
Wilmington, DE 19810
302-478-4063
Request software catalog.

CENTURION INDUSTRIES, INC.
167 Constitution Dr.
Menlo Park, CA 94025
415-321-0800
Request catalog of dedicated educational computers and compatible software.

DEVELOPMENTAL LEARNING MATERIALS (DLM)
1 DLM Park
Allen, TX 75002
214-727-3346
Request software catalog from vice president of marketing.

HARTLEY COURSEWARE, INC.
P.O. Box 431
Dimondale, MI 48821
616-942-8987
Contact Rosie Bogo. Request software catalog.

MICRO-COMPUTER EDUCATIONAL PROGRAMS (MCE) INC.
157 S. Kalamazoo Mall
Kalamazoo, MI 49007
616-345-8681
Contact Allen Kemmerer
Request dealer kit, which includes software catalog.

MINNESOTA EDUCATIONAL COMPUTING CONSORTIUM (MECC)
2520 Broadway Dr.
St. Paul, MN 55113
612-376-1118
Request software catalog.

SOUTHERN MICROSYSTEMS FOR EDUCATORS
P.O. Box 1981
Burlington, NC 27215
919-226-7610
Request catalog of software for special education administrators.

TEACHING TOOLS: MICROCOMPUTER SERVICES
P.O. Box 50065
Palo Alto, CA 94303
415-493-3477
Request software catalog and information about the use of computers in special education.

TEXAS INSTRUMENTS (TI), INC.
P.O. Box 10508
M/S 5890
Lubbock, TX 79408
800-858-4565
Request catalog of software and adaptive devices. Contact Mary Fesler 415-392-5700 for information about TI software and special education.

THE UPPER ROOM MICROCOMPUTER CONSULTANTS
907 6th Ave. East
Menomonie, WI 54751
715-235-5775
Contact Sam or Cindy Jenkins to request software catalog and information about special education and computers.

THE HANDICAPPED'S SOURCE a division of INTELLIGENT CONSUMER ELECTRONICS
526 Langfield
Northville, MI 58167
313-348-2793
Contact for catalog of software, hardware devices, books for the handicapped.

ZYGO INDUSTRIES, INC.
P.O. Box 1008
Portland, OR 97207-1008
503-297-1724
Request catalog of communication systems and assistive devices.

Administration
# of a
Microcomputer Laboratory

by
Jeanette M. Richardson
Office & Marketing Supervisor

Wisconsin Indianhead Technical Institute
New Richmond Campus
March, 1983

Administration of a Microcomputer Laboratory

by

Jeanette M. Richardson
Office & Marketing Supervisor
Wisconsin Indianhead Technical Institute
New Richmond Campus

Managing a Microcomputer Laboratory that encompases a multidisciplinary approach can prove to be a rewarding and challenging management prospect or it can be a frustrating and complexing job. The key to success is administrative and instructional staff support, advance planning, and communication.

The New Richmond Campus of Wisconsin Indianhead Technical Institute has within the last year put into operation a microcomputer laboratory, commonly known on campus as "The Apple Orchard." Although not a large facility, it serves the needs of the majority of the campus including the Office & Marketing Division, Agriculture Department, and some general education classes.

The present facility is--after only a year in operation--buldging at the seams! In the beginning, most of the faculty had not used a microcomputer as an instructional support tool or had hands-on experience in using one. Today, an increasing number of instructors are asking for instructional time in The Apple Orchard; and scheduling--both day and evening--has become a major concern.

How did this rapid change come about? Why are so many faculty incorporating the use of microcomputer software into existing courses? Why is the lab in operation almost continually from 8 a.m. until 9:30 p.m. five days a week? Why is campus management considering expanding into Saturdays and possibly Sunday afternoons as well?

The need to incorporate computer instruction and applications into curriculum was identified by both management and instructional staff, and an orderly process was put into operation to accomplish this task. Timelines for implementation were established, administrative support was given, and--most importantly--faculty members involved in the planning, implementation, and evaluation steps.

The rate of technological change today and the rate that individuals can adapt to this change leaves a managerial gap which must be addressed. (See Exhibit A.) In addressing this, the following nine steps were used in assisting the campus management team in developing, implementing, staffing, and integrating the Apple Orchard microprocessing lab into the total instructional process.

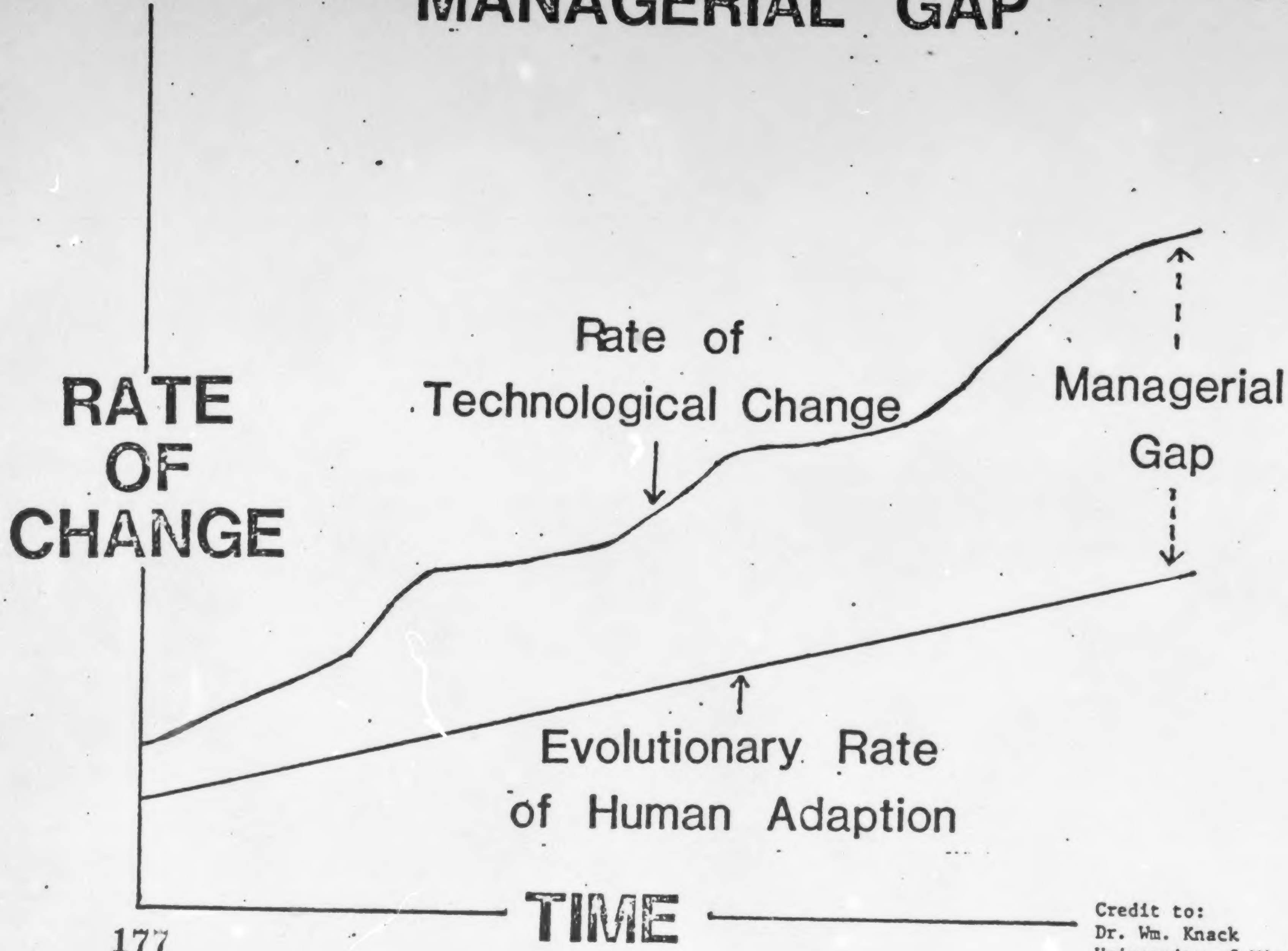
1) Establish goals and objectives
2) Specify evaluation criteria
3) Identify and organize planning structure and team
4) Access resources
5) Design system for implementation
6) Train staff
7) Design a recordkeeping system
8) Adapt/construct facilities
9) Adapt organizational structure

Goals & Objectives

With the assistance of local advisory committees, the need for training in computer literacy was established. The rapid changes in

EXHIBI[illegible] A

MANAGERIAL GAP



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Dr. Wm. Knack
University of Minn.
JR-7/82

today's business offices, on the farm, in manufacturing industries all indicated without question the need for basic computer concepts to be included in the curriculums. The actual amount of time and application to instruction was denoted by each area in the various technical fields.

In addition, applications were noted for adult basic education in such areas as reading, math, spelling, and grammar. Adults enjoy using the computer to perform what is generally regarded as remedial instruction. In this way, both the goals of computer literacy and educational fundamentals could be easily accomplished.

The inter-disciplinary utilization for the lab was established for a number of reasons. The main one, understandably, was the budget available to support the purchase of microcomputers. If each division/area would function as a separate unit and house the terminals in general classrooms, the availability for use of this equipment would be not allow for flexible scheduling. Therefore, management made the decision to establish one lab for use by the entire campus.

It was also an objective to foster a cooperative spirit among faculty from all divisions using this lab. The Campus Administrator designated the Office & Marketing Division Supervisor as coordinator for the development of the lab and related procedures, to work cooperatively with other areas of the campus.

Evaluation Criteria

This criteria as designated by management included a number of diverse areas:

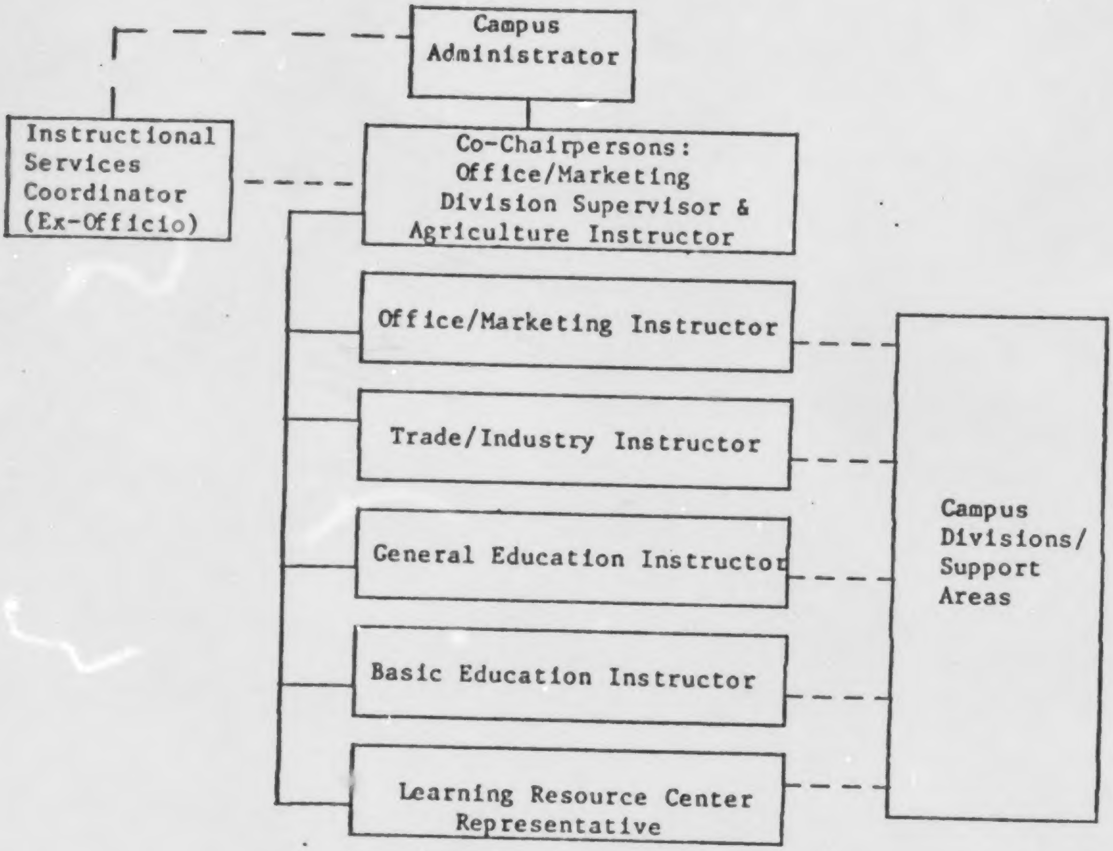
1) Inservice activities for campus instructional and management staff
2) Establishment of management procedures for lab
3) Software and hardware purchase/inventory procedures

4) Role clarification/procedures for Learning Resource Center
5) Establishment of machine maintenance and safety procedures
6) Role clarification of Campus Bookstore
7) Physical location of lab
8) Inter-disciplinary cooperation in use of lab
9) Budget for implementation and maintenance

These areas were set to be evaluated by campus management at the end of the school year. New criteria could be added as the need was shown throughout the year.

Planning Structure

A campus committee was formed in the fall to proceed with the establishment of guidelines for implementation of the microcomputer interdisciplinary laboratory. Co-chairpersons were identified by the Campus Administrator: The Office & Marketing Division Supervisor and an instructor knowledgable in microcomputer use from the Agriculture Department. Each division/area of the Campus nominated one instructor or support staff individual to serve on the Ad Hoc Data Processing Lab Committee. The makeup and organization of this committee was as follows:


Campus Administrator
Instructional Services Coordinator (Ex-Officio)
Co-Chairpersons: Office/Marketing Division Supervisor & Agriculture Instructor
Office/Marketing Instructor
Trade/Industry Instructor
General Education Instructor
Basic Education Instructor
Learning Resource Center Representative
Campus Divisions/ Support Areas

Each representative on the committee served as a liasion to his/her division or area. The co-chairpersons served as the committee's representatives in discussion with the Campus Administrator; the Instructional Services Coordinator was identified as an ex-officio and support staff committee member.

The committee was charged with developing and recommending procedures for lab management; student and instructor use of the lab; software requisitioning, receiving, and catalog procedures; bookstore responsibilities/involvement; machine maintenance and security procedures; lab safety rules; as well as recommending instructional inservice activities. A budget was recommended for implementation. It should be noted that generally committee members met on their own time or during scheduled office hours; this group operated in many respects much like a "quality circle."

One area that cannot receive too much emphasis is the role communication played in the developmental stage of this project. Both the campus management team and faculty were kept informed through one-on-one conferences and committee minutes as to the progress and recommendations being made by the committee. Concerns were discussed as they arose.

By the time The Apple Orchard officially opened, the staff (and students) were ready and eager to make use of this new facility.

Resource Assessment

The most obvious assessment is that of the actual budget available to support the lab. This was recommended by the Campus Administrator and communicated to the committee in the early stages of development.

Software adaptable for instructional purpose was investigated. At the time the lab was being orgainized, the greatest variety of instructional software available at an affordable cost was programmed to run on the Apple brand of hardware. The New Richmond campus proximity to Minnesota and the availability of MECC software was also considered.

The availability of "people" resources cannot be overlooked. The staff had at that time one instructor in the agriculture department (co-chair) who was very willing to share his expertise with other staff members. Four or five other staff members who had some basic knowledge also willingly lent their time to helping with the technical details.

Individuals from the local CESA agency and nearly universities were also called upon to assist.

Management Implementation Procedures

Lab Manager. Since on the WITI-New Richmond Campus The Apple Orchard is operated part of the time as an open lab, some workable form of control had to be put into place that could be monitored with relative ease. Since the campus budget could not support a paraprofessional at the time, the committee recommended that an instructional staff member be designed as lab manager to facilitate operations.

Student Users Guide. In consultation with the area CESA agencies and the University of Wisconsin campuses at River Falls and Whitewater, the committee adapted a "Student Users Guide for the Apple II+ Microcomputer" for use on Campus. Each student purchases this guide for a nominal cost from the campus bookstore. It contains information necessary to competently operate the microcomputer units.

Authorization Card. Before using a microcomputer, however, users must show proficiency by passing two short exams. After successful completion of these exams, a student is issued by the instructor a "Computer Use Authorization" permit card (See Exhibit B) developed by the committee.

The following procedures are in effect in the lab:

(1) Each user must obtain a Computer Authorization Card from the instructor before using a micro-computer terminal. This will be issued to the user only after s/he has successfully completed both of the following tests: Computer Language Test #1 and Computer Operation Test #2.

WITI NEW RICHMOND

Last Name First

Course Name - Number

Instructor(s)

Date Issued

> This Computer Use Authorization is your permit to operate computer terminals and to check-out - on a one-hour reserve - software materials from the LRC.*

1. This card should be filed in the Lab at all times except:
   (a) when you are requesting software from the LRC or
   (b) when properly displayed while you are operating a computer terminal in the Lab.
2. Enter the date and times you work in the Lab on the back of the card. This is your verification record.
3. Under no circumstances may you loan this card to another person.
4. If your card is missing, notify your instructor immediately.
5. Follow posted safety and repair procedures at all time.

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TIME OUT													
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LRC Software Checkout

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(2) The permit card should be displayed at all times in the card holder assigned to the machine when the user is operating a terminal.

(3) Each user should log in time and date on the card for each terminal usage.

(4) Under no circumstances may a user loan his/her card tc another individual.

(5) If card is lost, user must notify lab manager at once.

When an authorization card is issued to a student it also indicates that s/he may check out software from the Learning Resource Center. The LRC checkout procedure states that users may check out on a one-hour reserve basis a diskette (and optional instructional booklet) as designated by the course instructor. The LRC is open during customary day hours as well as designated evening hours.

Sign-Up Procedures. In order to maintain an accurate account of individual terminal use, each microcomputer is assigned a "Computer Use Log." Instructors may reserve terminals as needed for their classes. In addition, users can reserve one-hour blocks of time on individual terminals when the lab is not scheduled for a class. These logs are changed weekly by the lab manager and are maintained for reporting purposes.

The following procedures are in effect for use of the terminals:

(1) User should sign his/her name on the day and hour terminal is requested.

(2) A terminal is reserved for use until 10 minutes after the specified hour. After that time any authorized individual may use terminal;

user is thereby cautioned to be prompt in arriving at station reserved.

(3) Only one consecutive hour may be scheduled by a user.

(4) Terminal reservations may be made only one week in advance. Sign-up sheets for the following week are posted on Friday morning of the preceeding week by the lab manager.

(5) If a time frame is "X'ed" out, the equipment is available only to an assigned class and/or instructor and may not be used for open lab work.

(6) Each person using The Apple Orchard is responsible for care of terminals, diskettes, instructional books, etc. Work areas should be cleaned and normal housekeeping procedures observed.

(7) Lab manager should be notified regarding special problems immediately.

Maintenance & Inventory. A systematic approach to machine maintenance was a necessity. With minor modifications, the procedure already in place for the Office & Marketing Division was implemented.

Each user is responsible for machine maintenance in The Apple Orchard. If a terminal needs repair, it is the user's responsibility to see that a proper notation is made on the repair card for the lab manager's information. Presently a repair contract is in operation with the area CESA agency. The following procedures are followed:

(1) Each terminal, disk drive, and monitor is designated by a number.

(2) This number corresponds to a card in the Maintenance Card File.

(3) The student locates the proper card, notes on the next open line what is wrong with the machine, then initials the card.

(4) The card is placed behind the guide labeled "Repairs Needed."

(5) A piece of masking tape about 3" long is put on top of the piece of equipment needing repair. This notifies the lab manager that the terminal, disk drive, or monitor is in need of repair.

For inventory purposes, each terminal, disk drive, monitor, printer, etc. is assigned a number in the lab. This number serves a number of purposes. Students can log in reserved time for a designated station; the authorization card is shown in the numbered magnetic clip assigned to each station; maintenance repair cards are coded using these same numbers.

Safety Procedures. All users are required to be sure to adhere to safety procedures developed by the committee. Although most of these rules would appear to be "common sense," they are posted in The Apple Orchard for easy referral and as a reminder to lab users.

(1) All electrical cords must be kept clear of traffic areas.

(2) No equipment may be lifted or moved from its station without first consulting with lab manager.

(3) All drawers and cabinet doors should be kept closed when not in use.

(4) Aisles and walkways should be kept free of furniture, equipment, etc.

(5) Bracelets, hair, loose clothing/accessories should be kept away from movable machine parts.

(6) All items should be returned to their proper place after use.

(7) Chairs should be placed under desks when not in use.

(8) The lab manager should be notified of any potential safety hazzard immediately.

Security Procedures. Equipment security is essential in the Apple Orchard. Therefore, the campus welding class manufactured a simple, right-angle triangle devise (see Exhibit C). One side of the triangle is attached to the equipment. A security chain is then looped through the other side; this chain is locked to the desk top or floor. This procedure is repeated for every piece of equipment in the lab.

Staff Orientation

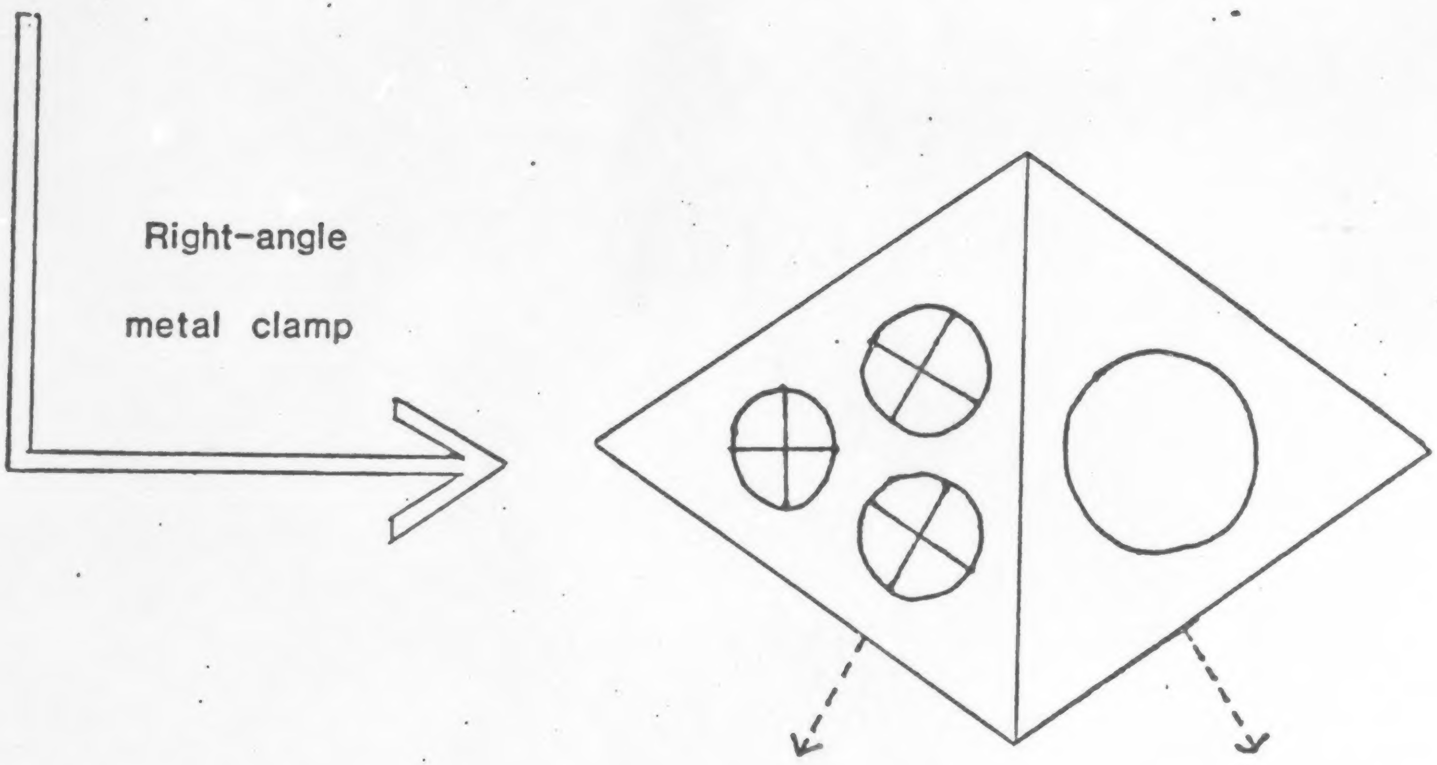
Any new instructional technique can be met with negative reaction. However, for the most part, this was not the case in implementation of the microcomputer lab on campus. Probably the acceptance is due in part to the inservicing given to both management and instructional staff.

A day-long inservice was conducted by area CESA personnel. Campus staff knowledgeable in the microcomputer area assisted. Prepared software in discipline areas was demonstrated, and each staff member had the opportunity to receive hands-on experience on a terminal before the end of the day.

In addition, evening courses have been conducted by the agriculture instructor who also served as the campus committee co-chair. These classes, open to community as well as campus staff at nominal cost, have been instrumental in bringing together individuals from a variety of interest areas. As commercial software has become more available, adaptations to instructional areas have continued to increase. Some staff has enrolled in programming courses and are developing their own software. Campus divisions willingly share information; the inter-disciplinary Apple Orchard has brought all campus departments together into a working relationship.

EXHIBIT C

SECURITY CLAMP



Right-angle

metal clamp

Attached

to machine

Security chain

looped through and

attached to floor or wall.

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More recently, a district computer specialist has been hired who is available to assist both management and instructional staff with technical concerns as well as in developing software instructional packages. This individual and the campus lab manager work closely together to support The Apple Orchard concept of maintaining a working inter-disciplinary campus approach to lab utilization.

Recordkeeping

In order to maintain an equipment and a software inventory, all purchases are coordinated through the LRC. This helps to avoid duplicaton of purchases and assure availability materials to all staff and students.

Software security is also a concern. To assist in identifying campus material, a bright green label was designed and is affixed to each software package received by the LRC.

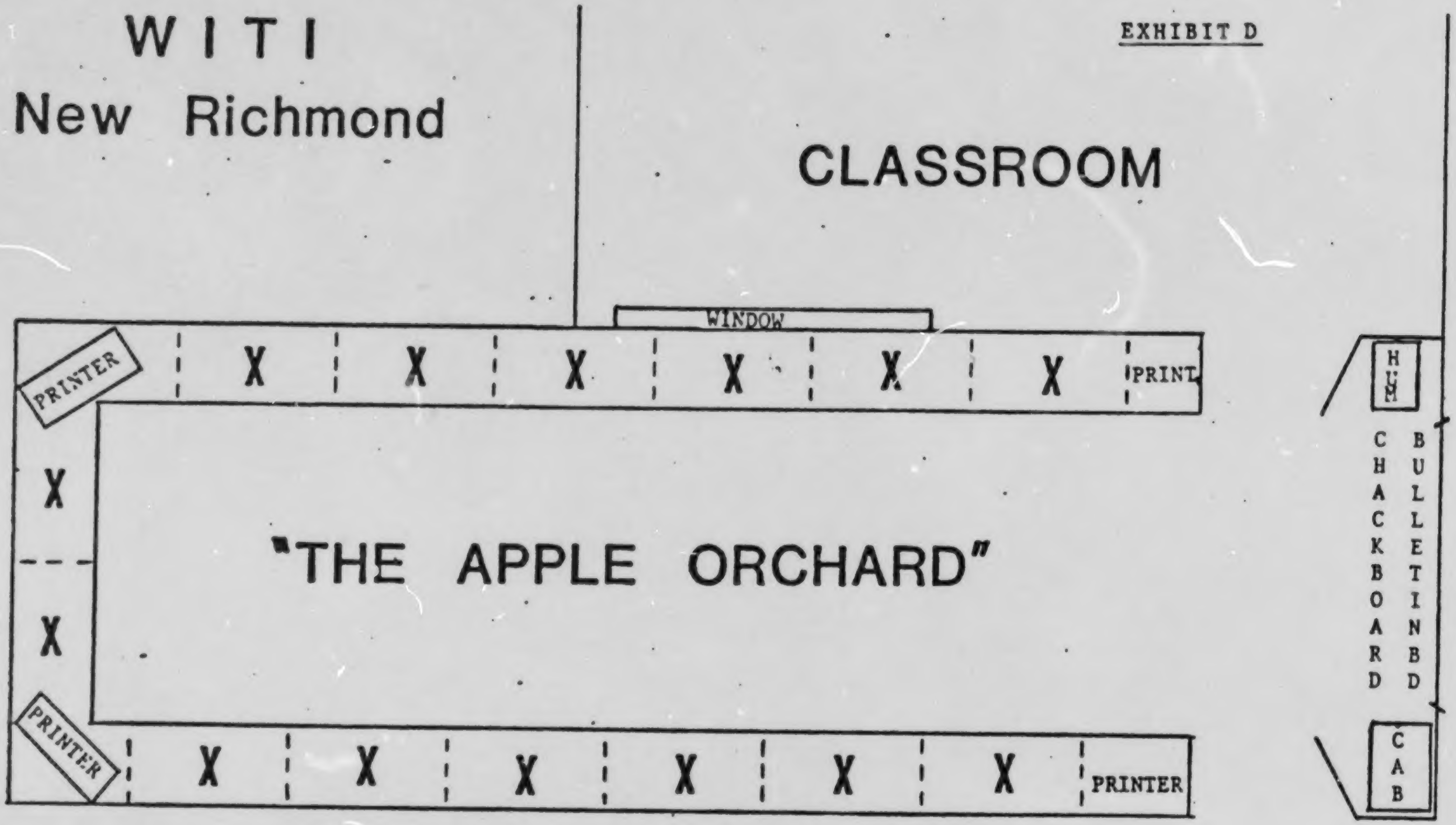
Campus Facilities

The New Richmond Campus, when designed less than ten years ago and constructed in 1976, did not plan for a microcomputer lab. Therefore, facilities had to be adapted to meet this need.

After much deliberation by the committee and the campus management team, The Apple Orchard (see Exhibit D) was located in the Office & Marketing Division area and near the LRC for ease in obtaining software for instructor and student use. An adjacent lecture classroom was deroted as necessary. Since instructors would have to work with students in both the classroom and lab during the class period, a window was installed between these two areas.

EXHIBIT D

WITI
New Richmond


CLASSROOM
WINDOW
PRINTER
X
X
X
X
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PRINT
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X
"THE APPLE ORCHARD"
PRINTER
X
X
X
X
X
X
PRINTER
HUM
CHACKBOARD
BULLETINBD
CAB

X = Apple II Units
Keyboard
Monitor
Terminal
Ten-Key Pad

--- Hall ---

Terminals are served by printers on a 3:1 or 4:1 ratio. A switch box was designed by the local CESA agency staff at nominal cost and installed by the lab manager.

A chalkboard and bulletin board were found to be a necessity as was a humidifier; chairs without rollers have been found to produce less static.

Since the New Richmond campus is experiencing a large growth in student population, a building addition is in the planning stages. When The Apple Orchard is relocated, physical facilities will be designed specifically to meet the needs of this inter-disciplinary microcomputer lab.

Adaptive Organizational Structure

The goal of establishing a microcomputer lab on campus has become a reality. It is, however, a changing structure which must be continually adapted to meet instructional needs.

The Ad Hoc Data Processing Lab Committee is today--a year after its conception--a standing campus committee, under the direction of the Instructional Services Coordinator. Committee membership is made up of instructional staff from each campus department and the LRC. Procedures have been modified and refined.

Evaluation is an on-going process. Repair procedures are of major concern. Also, a greater demand is being made on the lab manager's time as more staff and students request time in The Apple Orchard. Additional inservice time is required as new staff is hired. Facilities are in need of enlarging as more equipment is purchased.

These concerns and opportunities can be handled with relative ease because the basic organizational structure for implementation is in place. This management system, one that is flexible and adaptable, has met a campus need and been found to work. Technological change has been made to work _for_ individuals to enhance the instructional process.

The concept of people working together and communicating with each other has made what could have been a difficult situation into one that has created a sense of pride in the WITI-New Richmond campus staff and student body. The Apple Orchard at WITI-New Richmond is a reality and meeting inter-disciplinary campus instructional needs.

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THE OFFICE—TODAY AND TOMORROW

Opportunities for Vocational/Technical and Career Education

by

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Before contemplating the office of the future, one needs to reflect on the office of today. What is the purpose of the office of today? Will that purpose change in the future? The purpose of the office today and since its existence has been to process, generate, and move information (text, data, image, and voice). The office is responsible for servicing the total organization. In the future, the function of the office will not change dramatically but rather the way in which that function is performed will change. Through the utilization of advances in technology, procedures whereby information is processed, generated, and moved will be modified. The quantity, quality, and type of information generated may change, and the speed with which that information is generated will change.

Historians are referring to the present period of U.S. development as the Information Age. Where land and capital signified power in the Agriculture and Industrial Ages respectively, information is power in the Information Age. Management in business realizes the importance of information as a corporate resource and the need to manage information if quality and timely information is to be generated. Thus, managers are beginning to support the introduction of electronic information tools and procedures to foster the generation of quality and timely information. Vocational/technical and career educators need to keep abreast of developments in the Information Age if they are to prepare individuals to work in business today and tomorrow.

Status of the Office of Today

The handling of information in the office of today involves six phases: capture, creation, manipulation, distribution, storage, and retrieval. Six technologically-based subsystems have been developed to expedite the processing of information in each of these phases. The technologically-based subsystems include word processing, data processing, micrographics, reprographics, distribution, and retrieval. These technologically-based subsystems are made possible through the advent of the microprocessor. The microprocessor, a tiny silicon chip, which processes information, made the development of the microcomputer possible. The microcomputer, having a microprocessor as its central processing unit, is one of the information tools having the greatest impact on the office in the 80s. A variety of other automated tools have also resulted with the advent of the microprocessor. These automated tools include dictation equipment, word processors, microcomputers, intelligent printers, intelligent copiers, and facsimile machines.

Generation of Information Using Microprocessor-Based Tools

Information is captured in some offices today by electronic dictation equipment that is microprocessor based. Through the use of word processors or microcomputers, text and data are created on magnetic media. This information can then be altered as needed. Software programs allow the microcomputer operator to perform calculations on data and integrate this data with text. The data can be displayed as figures or in a form of graphics, using a graphics software package. Microcomputers are then used to distribute the data and text through an electronic mail system. Data and text can be stored on magnetic media (such as floppy and hard disks used in microcomputers). On demand, the data and text can be retrieved, displayed on a CRT (cathode ray tube), duplicated onto a disk, and/or a hard (paper) copy generated. The intelligent printer is driven by the microcomputer and thus can perform many printing functions without human intervention. Intelligent copiers in use today can then be used to generate multiple copies. The intelligent copy machine, comprised of a microprocessor used for self-diagnosis and control, can be programmed to do complex copying and collating jobs.

Through the technology of micrographics, data and text can be photographically reduced to a microform medium, used to record images that are greatly reduced in size in comparison with the original document, and stored. Types of microform in use include microfilm, aperture cards, and microfiche. One sheet of microfiche, a type of microform usually measuring 105 mm x 148 mm (4x6 inches) on which a group of images is arranged in rows and columns, can be used to store up to 270 data frames. Microforms can be generated directly from the computer by having data produced directly on film by a recorder from computer-generated electrical signals.

Moving into the Office of Tomorrow

However, not all businesses have these information tools at their disposal today. Nor do businesses have business information systems in place to facilitate efficient and effective use of these information tools.

Levels of information tools can be found in existence today in businesses. Chorafas (1982) challenges us to envision six levels of office automation as layers of applications, structured in a pyramid, four levels in existence in some businesses today and two levels yet to be implemented. Level 1 is the collection, storage, reporting, and distribution of data by different nonconnected devices. Information tools associated with this level include data entry equipment, electric typewriters, and copy machines of the 1970s. Electronic tools which might be found at Level 1 include dictation equipment and a mini- or microcomputer. Level 2 is the collection, storage, and reporting of text at the initial level of integration. Word processing, typesetting, and other office equipment that is microprocessor-based and compatible; i.e., capable of being integrated via a communications network, is identified with this level. Many of these information tools were introduced into the office in hopes of increasing the quantity of work generated; and, now, much of the emphasis is on generating quality work as well. Level 3 involves using communications capabilities to integrate separate processing functions. This level requires the interfacing of data processing and word processing for report generation. Also, through communications networks, electronic mail, executive calendar handling, time scheduling and other management information needs become feasible. Level 4 of office automation calls for personalized and customized office systems to support the professional activities of the employees by work station, integrating the office with the total computer resources of the business, and through these resources with voice and data networks. It is at this level that we see an integrated work station (terminal) at the disposal of the executive. An example of such a prototype is the Lisa, by Apple Computers, Inc. Level 5 involves the integration of computers and communications technology with management policy. The information tools, thus, are integrated through a communications network system designed to provide connectivity between a diverse range of tools. Procedures are developed for the use of these information tools after assessing the objectives at all levels of the organization in relation to the goals of the organization. These tools are then used to generate the information needed. Decisions are made based on the information generated in order to manage the organization and meet its overall goals and objectives. The sixth layer of the applications pyramid calls for computer-based decision-support systems,

> "enhanced through an invention of mathematical models to serve in forecasting, experimentation, simulation, graphic presentation, and allowing the user to plug in a series of givens and have the system generate the unknowns." (Chorafas, 1982, p. 22)

The first four levels are seen as being attainable by firms today. The majority of firms are estimated to be operating at Levels 1 and 2 of automation. It is at the fifth and sixth layers of the applications pyramid that the challenge presents itself. In order to integrate computers and communications technology with management policy and develop decision support systems, the ability to understand, design, and implement systems is needed. The technology and automated tools are here today. What is needed are business information systems in place which utilize the information tools. Through the use of these tools, the systems' capabilities and levels of performance can be enhanced.

Preparing For the Office of Tomorrow

As businesses embark upon moving up the pyramid in automating their offices, the preparation and planning they do will be of paramount importance.

Before investigating the information tools available, consideration of the business goals is a must. Then, through an identification of the objectives of the functional areas, departments, and/or divisions of the company, the activities necessary to achieve the objectives and thus reach the goals of the company need to be assessed. Which of these activities might be best accomplished through the use of automated tools need to be determined. Next, whether a common data base might be shared by functional areas to accomplish these activities must be assessed.

To ensure that the information generated is needed, and to be able to standardize procedures for performing the activity, a system analysis examining the work flow and delineating the procedure(s) used is necessary. Through this process, the paper generation process may be streamlined if it is determined that a given set of data or information is not needed. The procedures for generating information can be standardized, and the most efficient and effective way to generate that data might be determined.

Implications for Vocational/Technical and Career Education

Given that the office is in the midst of change with the advances taking place in technology, the very nature of the work environment is being altered. The work environment is having an impact on office personnel as each of the levels of office automation are being implemented in businesses. Changes in the procedures used to complete activities, fostered to some extent by the use of technology to perform various applications, are requiring that personnel be flexible and receptive to change. In addition, new skills and knowledge need to be acquired by all personnel in the office if an information system is to develop to meet the needs of the users. Given that the product of the office is information, a business information system needs to be put in place which will ensure that the information generated is timely, needed, and quality information.

Thus, the time is ripe for educational institutions to assess how they might best prepare individuals for the Information Age. The need exists not only to prepare students in our educational institutions but also those adults in the work force and those returning to schools who are considering re-entry into the labor force.

With the emergence of the Information Age, individuals are needed not only to work in business using the information tools generated by the new technologies, but also in industries created by the new technologies such as the microcomputer industry. In addition, individuals at all levels in business need to understand the capabilities and limitations of the tools and know how these tools can be used by them or others working for them to generate the information needed.

At the present time, a single discipline does not exist to address the preparation of individuals for positions in the office of the future; i.e., jobs within businesses related to the development and management of business information systems. Instead, businesses are proceeding by having vendors train personnel on the information tools purchased. Personnel are also being sent to the multitude of seminars being held throughout the country on topics ranging from word processing to networking and data base management, in an attempt to develop a cohesive business information system. Many firms are spending a considerable amount of money through in-house training programs.

Students continually seek advice on courses they might take to prepare them for the changing labor market. In many instances, students are being directed to courses in a variety of disciplines, including computer science, educational technology, engineering, and newly formed administrative information systems and information management departments. Thus, vocational education service areas need to continue to update their programs and curricula if they are to continue to be a viable medium for the preparation of individuals they have been serving. Approximately 60 percent of all secondary students were enrolled in federally funded vocational education secondary school classes in 1976 (Grant and Eiden, 1980). An estimate of 1.39 million students were enrolled (Grant and Eiden, 1980) in noncollegiate post secondary schools in 1976. Vocational and technical schools as well as collegiate institutions may find it advantageous to articulate in defining the scope of the Business Information Systems discipline and what the discipline might aspire to accomplish at the various levels of education.

Issues and Opportunities For Vocational/Technical and Career Education

As the jobs are changing in the handling of information and some jobs are being eliminated, given the ability to generate more information in a shorter time span with new technology such as word processors, some members of the work force are resisting these changes.

Attitudes Toward Change

Attitudes toward changes such as the introduction of the microprocessor-based technology need to be addressed in vocational/technical and career education programs and courses. Individuals must be change-oriented if they are to be satisfied working in the office of today and tomorrow. While changes have been occuring at a rapid pace, change will continue in the office environment. While the technology for the office of tomorrow is here now, people need to be ready to use and to accept the new technology.

Career Education and Counseling

Given the shortage of career counselors to assist students with the career decision-making process, the computer-based information and guidance systems now available will become more important as new career paths open up. Through the use of microcomputers in school settings, community settings and in the home, more individuals will be able to have access to career decision-making systems.

Individuals need to be knowledgeable about the type of environment they are preparing to work in to assess whether that work environment will meet their job satisfaction needs (both internal and external). While they may find the anticipated wages for the position they aspire to prepare for to be attractive, they may not be happy with the work environment. For example, when word processing was first introduced, the concept of administrative secretaries and correspondence secretaries also came into vogue. Word processing centers were formed. Correspondence secretaries (word processing operators) were housed in a word processing center. Many of these correspondence secretaries had previously been traditional secretaries. The center environment, in which they were isolated from contact with the authors of the documents they were generating, was foreign to many of them. The isolation and lack of people contact caused anxiety and often resignations among these workers. To alleviate the problems caused by the word processing center structure, many firms have since introduced decentralized structuring patterns such as satellite stations. However, the anxiety and resignations caused by the word processing centers might have been kept to a minimum. The personnel responsible for the management of the office need to have an understanding of the factors impacting on the office environment if they are to be able to forecast how changes in these factors might impact on the personnel.

Preparation for Information Managers and Users of Information Systems and Tools

Thus, vocational and technical education programs preparing individuals to manage information in business must strive to develop in students the ability to conceptualize the total business information system and to analyze the system components before making changes in the system. A system has as its components people, technology, and procedures. Considering each of these three components in designing a system and before making modifications in a system is imperative if maximum efficiency and effectiveness is to result in using the system. The ability to design new jobs with not only the technology and procedures in mind but the people as well facilitates job satisfaction and acceptance by the people. In addition, the need to redesign jobs receiving input from the people who have been performing the jobs is a must. Research studies have shown individuals will be supportive of change if they have had input into the decision-making process bringing about the change. However, if individuals are to have input into the decision-making process, they must be prepared for and capable of participating in the group decision-making process. Many individuals in positions below the mid-management level have not had the educational background to prepare them for taking an active role in the decision-making process. Many of these individuals appear reticent to make suggestions and somewhat intimidated by their supervisors. In sum, talent must be developed to manage the changing environment.

Knowledge and Skills for Users of Information Tools

Vocational and technical education courses and/or programs preparing individuals who will be using the information tools in the office must assess what skills and knowledge can be best taught on the job and the generic skills and knowledge that can be taught in the school setting and transferred to the work setting.

With many of the routine jobs being performed automatically through the use of information tools, the issue arises as to the complexity of the skills which should be taught in an educational setting. Concern arises as to whether many of the entry-level skills previously taught will no longer be necessary given that routine jobs will be automated. Thus, the emphasis being given to the levels of the cognitive domain in preparing individuals for positions in business needs to be assessed. Where the knowledge and comprehension levels of the cognitive domain may have been stressed in the past, the higher cognitive levels of application, synthesis, and evaluation may need to be developed further. For example, microcomputers might be used to facilitate an understanding of several technologies—word processing, data processing, and telecommunications. Given that word processing packages for microcomputers are not as sophisticated as those developed for word processors, the learner must develop a deeper understanding of the operation of a microcomputer to perform text processing. The knowledge and skills learned in using a microcomputer can then be transferred to a word processor for text processing. Through instruction on the microcomputer, data processing concepts can be taught as well. The integration of word and data processing for report generation can then be taught. Students can also be introduced to the development, use, and management of a data base. Through the use of data base management software, students can learn to generate financial reports for a business and discuss the use of the reports for decision-making in a firm.

While it will be important for those in our business offices to use the information tools, they need not become technicians or computer programmers. As the new technology is perfected, additional aids to simplify use of the tools are being introduced. The issue that the tools will not be used by executives unless they are easy to use is presented in many trade journals. Thus, we have seen manufacturers of these information tools attempt to design them to be easy to use and require a minimum of training. Executives and other office workers should perceive the microcomputer and other technology aids as tools to assist them in performing their functions and thus the means rather than the end. The product is information, and it is imperative the end not be lost sight of.

Another issue relates to what preparation or knowledge and skills are needed to use office automation in performing executive tasks. An issue which has arisen is whether all individuals in educational settings should be required to learn keyboarding skills in preparing for the electronic office. Executive work stations and terminals will be on the desks of the majority of business workers as we approach the 20th century, and many contend a substantial amount of time can be captured by increasing an individual's keyboarding facility. Schools may want to consider strongly offering keyboarding instruction for all students.

Role of Vocational/Technical Educators and Business in Preparing for Automation

The issue relating to what role vocational/technical education will play in preparing individuals for the automated office and what role will be played by the businesses themselves must be addressed. No doubt businesses would be pleased to have the vocational and technical institutions do more of the education and training needed if they are assured those prepared would have the knowledge and skills needed for given positions. Thus, it is imperative vocational and technical educators and their institutions work closely with businesses in developing their programs and curricula. The time lag between introduction of new technology into businesses and into the educational environment can no longer be tolerated. Through cooperative endeavors between business and industry in efforts such as cooperative education programs, the gap between business and education for business can be narrowed. In addition, sharing of resources and internships for students as well as vocational/technical and career educators can help keep those in academia abreast of the latest advances in technology and accompanying changes in systems and procedures. Business will benefit in helping to develop the abilities of students who can be productive in their environment. Vocational/technical educators will benefit in understanding the problems confronted in business and in being able to keep abreast of changes and take this information back to the classroom. Through cooperative research efforts with business, educators and business personnel can benefit to solve business problems. The possibility of sending faculty on sabbaticals to business and drawing upon the expertise of business personnel in the classroom also has merit. Barriers to such cooperative efforts need to disintegrate if vocational and technical institutions are to be able to prepare individuals for the changing office environment.

Innovative Methods of Instruction

New innovative methods of instruction will result from the introduction of microprocessor technology and the networking technology made possible through telecommunications. A greater number of students will be able to be served by vocational and technical educators. In particular, those adults gainfully employed who are interested in updating their knowledge and skill or in retraining will be able to receive instruction via a networking system in their community, at their workplace, or within their homes. In the past, adults often were inconvenienced and had to make sacrifices in order to prepare for their changing job roles. While the trend in the last decade has been for major corporations to provide in-house training programs for employees, the trend may reverse itself if vocational and technical educators take the lead, meet with business personnel to find out what type of education and training programs they perceive to be critical, and use the communications technologies available to deliver the programs. Through an increase in its market share, vocational and technical institutions will be able to afford the new information tools required for instruction.

Conclusion

In conclusion, the Information Age presents vocational/technical and career educators with an opportunity to work with businesses in preparing individuals for the changing work environment. Through cooperative efforts, vocational/technical and career educators will be able to be more thorough in their efforts to prepare individuals who can work in the changing office environment and individuals who can manage change.

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Computer Assisted Developmental Guidance

by

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Introduction

Counseling and Guidance is continuously being buffeted by the psychological, sociological and anthropological information explosion. A recent, major source that may have greater impact on this field than any other is computer technology. If Toffler's (1980) concept applies, Counseling and Guidance may be entering a third wave - a period in history when changes in personal and social growth and understanding will occur at geometric rates.

It is our belief that Counseling and Guidance will continue to exist, and may indeed flourish, if practioneers of the profession are able to become conversant with new technology and are able to develop strategies for marrying new technology to the principles and practices of Counseling and Guidance.

The purpose of this paper is to present one way for bridging the gap between technology and Counseling and Guidance. More specifically this paper will present a brief overview of a developmental counseling perspective, and highlight a number of ways computer technology can be incorporated into the developmental perspective and be utilized to facilitate accomplishment of goals and objectives.

A Developmental Perspective

Counseling and Guidance is a timely service that is appropriate for individuals as they develop in a world that is continuously changing. A number of authors have addressed this process (Blocher, 1966; Byrne, 1963; Farwell, 1979; Peters, 1970). Tested assumptions underlying this developmental process are:

(1) Clients are constantly growing, changing, and developing.

(2) Clients have changing physical and social characteristics that may alter their mental processes.

(3) Clients are unique.

Developmental counselors utilize the above assumptions as they intervene in their client's lives. Developmental intervention usually takes one of three forms, i.e., remediation, prevention, or productivity and is activated through one or more of six counseling functions, e.g., individual intervention; small group intervention; large group intervention; consultation with significant others; program design and administration; and/or research and evaluation.

By using combinations of these three forms and six functions counselors are able to help clients to become self competent. Farwell (1979) in discussing this goal suggests that developmental counseling is a process in which individuals are provided opportunities for (1) assimilating new information, (2) learning productive means for reporting or discussing how new information affects their thoughts or conceptualizations, (3) demonstrating new integrated behaviors, (4) integrating old concepts and areas of self awareness with new inputs, (5) making decisions that are current and open to feedback, (6) accommodating new stimuli in a growthful manner (7) and restructuring in a helical manner so that there is continuous movement in an upward or forward direction.

Perrone (1982) approaches developmental counseling from a slightly different perspective. He outlines specific attitudes that can be the focus of a developmental guidance program. He suggests that counseling should help clients achieve

1) A SENSE OF WORTH - respecting oneself, knowing what is right and wrong for self, and having a desire to be understood.
2) A SENSE OF UNIQUENESS - valuing one's novel perception of self, others and the environment.
3) A SENSE OF DIRECTION - making progress toward accomplishing one's own life's tasks.
4) A SENSE OF SELF-SUFFICIENCY - acquiring the skills needed to insure satisfaction of human needs, successfully adapting to uncontrollable roles, rules, and structures.
5) A SENSE OF BELONGING - identifying with and being accepted by those from whom one derives his/her values, caring for and being cared for by others.
6) A SENSE OF POTENCY - expecting one's behavior can largely determine the occurrence of a desired outcome.
7) A SENSE OF COMMITMENT - personal meaningfulness, belief in some certainties in a world of probabilities and change.

In summary, developmental counseling is based upon the belief that individuals are continuously changing and that they are interdependent with a world that is also in a state of transition. Counselors interact with their clients in a variety of ways. All of their approaches are aimed at helping clients to be self aware and self competent.

Computer Applications

The developmental perspective outlined above suggests growth, change, and/or movement. All suggestions and perspectives are dependent upon information collection, storage, retrieval, and analysis. Developmental counseling cannot occur without accurate data - data that is accessible to the human system and useable by it.

It is at this point that computer technology becomes important. The major asset of the computer is its information handling ability. The micro-computer brings information storage, handling, analysis and retrieval to the counselor in a way that has never before been available. The information function is central to Guidance and Counseling. With increased information handling capabilities Counselors will no longer have the excuse of not being able to collect, store, analyze or retrieve information needed to promote growth and development of students within the educational environment. The difficulty that becomes apparent is deciding on what information is needed to promote development for which goals. The micro-computer provides the following possibilities for counselors:

(1) STORAGE OF STUDENT RECORDS - General school records as well as records specific to counselors can be maintained. Storage on microcomputer disks is more efficient than through paper and pencil files; records are more readily accessible, and records can be changed more conveniently.

One note of caution, however. Confidentiality of records, as always, is important. Computer wise clients may be able to alter records. Therefore, the use of "passwords" and identification keys is recommended.

(2) DEVELOPMENTAL ASSESSMENT - Instrumentation could be developed to assess various developmental domains, learning modes, classroom environments, and school environments. These in turn can be scored easily and quickly on the micro computer. Data collection of this kind can vastly improve the counselor's ability to organize needed resources and to provide optimum growth environments.

(3) NEEDS ASSESSMENT - Several programs have already been written and are available for specific student needs assessment. (Instructional Enterprises, 1983.) For example, Self-Concept, Money Values, Parent Relationships, Stress, Vocational Values, Occupational Orientation Matrix, Study Skills, Study Attitudes, and Creativity, are "game" type programs "played" by students who learn about themselves by obtaining profiles and explanations. These programs automatically store item and total scores on disks by sex so that counselors can assess student attitudes, values or needs. Such information can provide a basis for program development for client or group intervention.

(4) COUNSELOR RESEARCH - The micro computer allows counselors to maintain specific records for assessing the effectiveness of the developmental counseling program or of specific intervention strategies. Counselors can utilize data obtained from the above Needs Assessment instruments and from tests, questionnaires, or inventories designed to measure specific client parameters. From a research perspective the microcomputer can be used to collect

the data (have students respond on the keyboard); store the data; and analyze the data. Efficiency and effectiveness is enhanced.

(5) COUNSELOR ACCOUNTABILITY - The micro-computer provides a means for easy maintainence of counselor activity records and for compilation of accountability reports. Specific software programs, e.g., the Counseling Goals System, Counselor Activity Log (Instructional Enterprises, 1983) and List Handler (Silican Valley Systems, Inc., 1982) provide systematic procedures for storing data in a manner that is readily classifiable, accessible and retrievable. Analysis of a week's work, a month's work, or a year's work is immediate. Accountability is faciliatated by being able to analyze effectiveness on outcomes and with specific interventions.

(6) COUNSELOR INFORMATION SERVICE - With the micro computer counselors could offer scoring services for analyzing teacher made tests with the resulting effect of obtaining continuous assessment data about the achievement of students within specific classes or for comparisons across classes. This approach has two desirous effects. First, counselors could have updated current data about student achievement. Second, counselors could be seen (and rightfully so) by teachers as being interested in the total educational domain. Cooperation between professionals should be enhanced.

(7) CONSULTATION ON COMPUTER ASSISTED INSTRUCTION - Counselors with training in the use and application of the micro-computer would be in an ideal position to consult with teachers concerning the application of computer-assisted learning.

As in (6) above counselors can help teachers to provide quality education - education that is cognitively and affectively relevant.

(8) COUNSELING AND GUIDANCE SIMULATIONS AND COMPUTER ASSISTED INSTRUCTIONS - Decision-making, problem solving, course-major choices, and simulated life events, are some of the simulations that can be used in the guidance instruction of students.

The computer can be used to provide the stimulus and analysis. Individual intervention, small groups, or classroom settings can be used to follow up materials and provide an opportunity for tailoring counseling interventions to the needs of students.

(9) VOCATIONAL INFORMATION SERVICE - Information systems such as the WISC are available for micro-computers. Other vocational information services will probably become available as more counseling departments turn to the use of micro-computers.

(10) EDUCATIONAL PLACEMENT - Counselors can use already existing word processing software to develop automated production of college applications, resumes, and reference letters.

11) PUBLIC RELATIONS - Word processing, mailing lists, and data base software provide counselors with the tools to produce many kinds of letters, reports, news items, etc., to be used in promoting the guidance and counseling function. Progress reports, letters of information concerning specific topics, happy grams, etc., can be easily produced and targeted to specific groups for mailing or distribution. These kinds of software also allow such documents to be personalized automatically in a manner consistent to the uniqueness of individual students.

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he ideas presented above are specific ways computer technology an be sed to foster achievement of Counseling and Guidance goals. In more general way computers can

) Help counselors to gather and use data more effectively. Computers lend themselves to data collection whether through keyboard inputs or card sort interface systems. Also, retrieval and analysis is efficient and accurate.

) Allow counselors to utilize the six counseling functions of individual intervention, group counseling, classroom teaching, consultation, program design and administration, and research and evaluation. It can do this by providing a means for more efficient use of time. One example, testing and analysis can be done with the computer. Counselors can use the resulting data to provide students personal implications. Eventual decisions can result from student - counselor interactions that are based on test results.

All six functions can be augmented by the computer. Individual interventions and small group procedures can be effective processes for providing students opportunities for discussing issues and/or questions raised through their computer interactions. Classroom presentations can use the computer for providing simulations, demonstrations, examples, etc. Consultation can be facilitated through the record keeping capabilities of the computer and through computer assisted trend analyses. Program design and administration is dependent on efficient record keeping, the ability to see relationships between variables, and effective cost analysis. The computer can be very helpful in all of these areas. Finally, research and evaluation is dependent on assessment. The computer's facility for inputing, storing, retrieving, and analyzing data can make assessment richer qualitatively and quanitatively.

C) Provide counselors more time to work directly with students. The computer can be used to remove one of the major obstacles to effective counseling - too much paper work. Used properly, technology can humanize interactions.

D) Provide students immediate feedback. The computer can provide an opportunity for assimilation of new materials, a chance to develop new behaviors, a means for integrating old concepts with

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new ones, a stimulus for practicing decision making skills, and a meaningful way for students to practice cognitive restructuring.

Conclusion

Computers and computer technology will be an advantage if counselors creatively seek ways for integrating them into their counseling programs. If they do the potential for educational benefits is unlimited. The major limitation on the computers usefulness rests within counselors. Hesitation or fear of utilization is the greatest obstacle. With adequate integration of technology, Counseling and Guidance will lead a robust life in the years to come.

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USING MICROCOMPUTERS FOR CAREER GUIDANCE INFORMATION

By Roger H. Lambert, Ph.D.

Microcomputers in the guidance program are a relatively new development. While computers and computerized career information systems have been around for about fifteen years, the utilization of the stand alone microcomputer for guidance functions is something that has developed in the past three years. Currently, the numbers of microcomputers used in guidance is estimated to be very small. This, however, is expected to grow at a rapid rate over the next five years. In a recent report of a study of Career Information Systems in Secondary Schools, only 24% of the schools had computerized career information available (Chapman, 1983, p. 167). The report was based on a 1977 study. This represented primarily main frame guidance systems. No current estimate of numbers of microcomputers in guidance exists, but the area is expanding rapidly. For example, in 1980-81, few, if any, micros were in use in Wisconsin for guidance functions. In 1981-82, about twenty-five sites used micros, and in 1982-83, over 125 sites had career information available on micros. On a national basis, a report on the Status of Statewide Career Information Delivery Systems indicated that in 1982, twenty states were offering microcomputer options to their system users and that two additional states would be offering micros in 1983 (Dunn, 1982, p. 7). This rapid expansion of micros in the past three years is opening the world of computers to many more users than ever before.

What Can Micros Do For Guidance Information?

Microcomputers have brought computing power within reach of the Guidance Department or Career Counseling Center. This is significant from the standpoint of ease of operation, reliability, and student access. With the microcomputer dedicated to the counseling or career center, the counselor is in control of the program, and the students have full-time access. Likewise, the counselor now has hardware that can operate a variety of software programs which may be applicable to the students. Previously, the program on the main frame dictated the software that could be used, and the conditions and times of use were often dictated by others.

Microcomputers organize and retrieve information more efficiently than any other means. In career guidance, there is a need for a vast array of information on occupations, educational programs, colleges and vocational schools, financial aids, and on other related topics. The computer can easily organize the thousands of pieces of information and return them on command. Likewise, it can be interactive and ask a series of questions or initiate a series of activities for a student and then translate the results into selections for occupations, colleges or financial aids. Microcomputers are not substitutes for printed materials, but they are the most efficient way to organize and retrieve information.

Microcomputers provide quick access to information. This is especially important in the Career Counseling Center. With one counselor to 300 or 400 students, it is important that the counselor have a means by which the student can access information on careers and career planning rapidly. The computer does this better than any other device. It can do this routine task over and over again providing impartial responses in a matter of minutes no matter how often it is asked.

The use of the microcomputer to provide career information serves to stimulate student interest in seeking out the information. Currently, computers are high on students' interest list. Thus, using one in the guidance process will stimulate more students to participate. Likewise, the availability of the microcomputer to the student encourages the individual to seek information as they have need for it.

Microcomputers extend the scope of information available. No one individual or career center staff person can ever have all of the information at their fingertips which is needed to answer students' questions unless they have access to a computer with the information stored on it. The use of the computers greatly expands the scope and comprehensiveness of information available to students and the counselor.

The microcomputer increases the number of students who have access to information. The microcomputer can be available all day, every day, including before school, during lunch hours and coffee breaks, during staff meetings, and after school; thus many more students can access information at a time when they are available. Most information access programs are relatively quick and can be carried out in a class period or less. More sophisticated programs which take longer have built in record systems that remember who the student is and what has been done to date.

Microcomputers can improve the guidance process by allocating routine information searching and reporting to a computer. The delegation of these tasks to the computer will free up the counselor for more substantial work with the student in decision-making, interpreting interests and abilities, and in putting information to use in a career plan. Likewise, the student will be better prepared to make decisions once they have access to information. Easy access to information will greatly enhance their ability to compare and rethink tentative decisions.

What Kind of Guidance Information Is Available for Micros?

Occupational Information: A number of programs are currently available for use on microcomputers which will search occupational files based on answers to questions which students input into the computer. These programs vary in scope from a few hundred occupations to several hundred and information provided varies from reference to printed data to complete detailed occupational descriptions comparable to those found in a main frame computer system. The micro systems which encompass the detailed information require additional disks, or a hard disk for storage of this data. Occupational search strategies available vary from structural questions which result in an occupational profile, to direct access to an occupation by number or code.

Educational information: Like information on occupations, educational information is well suited to the microcomputer. Information on colleges, vocational schools, programs of study, tuition, competition, enrollment, etc., can readily be stored and retrieved as needed. Data from hundreds of schools can be stored, searched, and retrieved as the student accesses the system.

Financial Aids Information: Scholarship and financial aids information can readily be stored on a microcomputer. Access can then be done based on a variety of criteria. In addition, the microcomputer can be programmed to provide a sample eligibility exercise for students to complete which will help them to determine the aids for which they might qualify.

Interests, Values, and Decision-making Skills: Microcomputers provide an excellent vehicle for students to explore interests, values, decision-making skills, and other career-related activities. While interests, values, and decision-making skills may not be considered information, they are closely associated with most career information systems. Search strategies for careers and post-high school educational institutions are frequently tied to interests and values and the whole process brings career decision-making into play. The interplay of a student's interests and values can be interrelated into the career and educational search process. Likewise, decision-making skills can readily be practiced as part of specific programs for this purpose as well as part of most occupational and educational search strategies.

Life Skills, and Prior Experience Assessment: This is an information area which is unique for each individual, but relates directly to occupations and educational program choice. Determining life skills which are related to one or more occupations can be available via the microcomputer. Through a series of exercises, an individual can identify past significant experiences and then relate them to occupations. This can then be carried to the next step to determine the most appropriate program of study to take to achieve a new career goal.

Student Records: Micros are an effective way to systematize counseling records pertaining to students. A counselor log or schedule can easily be kept with pertinent information recorded on each student as counseling services are provided. Thus each time a student comes in, the record can be called up for instant review. Records of this nature are easy to maintain and can be confidential.

How Do You Choose Career Guidance Software?

Choosing an appropriate career information or career guidance system is a major task. To do so, a number of considerations must be carefully reviewed. These considerations not only include the program content and philosophical base, but also the operational requirements such as time, complexity, and equipment. The choice of component software programs should be done in a similar manner, but is usually less complicated and much less time consuming. Component programs are usually low in cost, can function independently of major systems and are typically single purpose, so the decision to purchase is not as difficult as when buying a major career or guidance system.

A selection checklist for choosing a major career information or guidance system is provided in How To Select a Computer-Assisted Career Guidance System, (Maze, 1982, pp. 147-150). The check list is presented below.

I. System Goals

  A. The structure of each Computer Assisted Career Guidance System (CACGS) is determined by its philosophical assumptions.
    1. According to system literature, what are the essential elements in the career planning process?
    2. What role is the CACGS intended to play in this process?
  B. The objectives of the CACGS should be similar to those defined by your institution.
    1. What are the outcomes it intends to achieve?

2. What population is it intended to serve?

C. After noting the limitations of the CACGS, are these services your site is willing to provide in another way or do without?

II. Didactic Components

A. Which concepts does the CACGS attempt to explain? Common topics include:

1. An overview of the career planning process.
2. The values clarification process.
3. How to make rational decisions.
4. The structure of the world of work.
5. How to use information resources.
6. The job search process.
7. How to obtain financial aid.

B. How effective are these components in teaching the concepts they attempt to teach?

1. Are the topics presented in an interesting and lively manner?
2. Are these modules fully interactive?
3. Is this information relevant to your client population?
4. Is the material written at an appropriate reading level?

III. Assessment Components

A. On which topics is the occupational and/or educational selection process based? Commonly used topics include:

1. Aptitudes
2. Abilities
3. Skills
4. Interests
5. Client preferences (job or school characteristics)
6. Values
7. Personality types

B. Are these assessment components effective in selecting relevant occupations and/or educational programs?
   1. Does the access strategy enhance the career planning program used by your institution?
   2. Are there aids to self-assessment which help the client to answer the questions accurately?
   3. Is there a carefully researched data base which relates the occupations or educational programs to the self-assessment topics?
   4. Is the logic of these components easy to understand and realistic?
   5. Are the topics relevant to your clients?
   6. Do these modules make full use of the interactive capabilities of the computer?
   7. Is the reading level appropriate to your clients?

IV. Information Components

A. Which types of information are covered? Common types of information include:
   1. Occupational descriptions
   2. Educational programs and institutions
   3. Bibliographic resources
   4. Military occupations and training programs

B. How well are these topics covered?
   1. How detailed are each of the descriptions?
   2. Is the reading level appropriate for your clients?
   3. Are the files updated frequently and is the information accurate?
   4. Is it possible for individual sites to add local data?
   5. Is the information localized to your region or state?
   6. What sources are used to collect data?
   7. What philosophy is used in interpreting the data?

V. Internal Structure

A. How easy is the CACGS for an unsophisticated client to use?

1. Are all parts of the system cross-referenced to other parts to facilitate movement between components?
2. Are the instructions easy to understand?
3. Does the CACGS allow the client flexibility in deciding in which order to use the components?
4. Is the system adaptable to the complex needs of your clients?

B. How was the system intended to be used?

1. How much time does the average user need?
2. How many sessions do most users need?
3. Does the system store a record of the client's progress?

VI. System Management

A. There should be support materials which clearly explain the structure of the system for counselors and supplement the computerized materials in special situations.

1. Does the counselor's manual explain the objectives and logical structure for each component?
2. Are user materials easy for your client population to understand and available in sufficient quantities?
3. Are there audio visual aids to supplement verbal instructions for poor readers?
4. Are there exercises and activities recommended for special populations?
5. Is there a manual sorting process which can be used when the computer is not available?
6. Are the information files available in books or microfiche when the computer is not available?

B. CACGS should provide technical support and should be responsive and prompt in fulfiling their commitments.

1. Is in-service training available from professionals who understand the counseling process?
2. Is the CACGS responsive to the suggestions from users?
3. Does the CACGS actually keep the data as up-to-date as it claims and are the updates produced on a dependable schedule?

C. CACGS should have evidence of careful evaluation during their formation and continuing evaluation annually.

1. Has the CACGS been carefully evaluated to determine its effect on users?
2. Is there a process for collecting data about usage at each site?
3. Is there an ongoing evaluation process for the system as a whole?

VII. System Requirements

A. What types of hardware are recommended for usage with the CACGS? Specifications should include:

1. Computers
2. Terminals
3. Telecommunication modes
4. Other optional or recommended equipment

B. Does the hardware you plan to use have a good record of dependability in settings like yours?

1. How much down time does the computer average per year?
2. Can the log-on procedures be simplified for your settings?
3. Have other sites using similar equipment found it reliable?

C. What is the per user cost of this CACGS in your setting?

The selection of component or stand alone career or guidance information software should be done in a rigorous manner even though not all of the system checklist criteria will apply. In addition to using the appropriate sections of the system checklist when choosing software, it may be appropriate to evaluate the software against the following Computer Software Selection Checklist which was adapted from one used by the Minnesota Educational Computing Consortium. This checklist, which follows, while less specific, may be sufficient to determine the value of a component software package.

A. CONTENT

1. Is the content appropriate to your needs? Yes No
2. Does it support your counseling objectives? Yes No

B. OPERATIONAL DESIGN - Numerous types of programs are available. The following are common examples and some of the concerns of each:

1. Drill and Practice - provides practice for a skill taught previously.
   a. Is there a variety of levels of difficulty? Yes No
   b. Is additional practice provided as needed? Yes No
   c. Does the program provide management feedback-record student performance? Yes No
   d. Are positive and negative feedback given, as well as any necessary hints? Yes No
2. Tutorial - conducts actual instruction, generally in the form of a dialogue between the student and the computer.
   a. Is there an appropriate amount of interaction? Yes No
   b. Is evaluation included? Yes No
   c. Can appropriate segments be accessed by the student without going through the entire sequence? Yes No
3. Simulation - generates models of environments, experiments, etc.

a. Is there a reason for using a simulation rather than actual experience, for example, danger or expense? Yes No
b. Are opportunities to generalize provided? Yes No
c. Is graphic representation utilized? Yes No
d. Are any assumptions identified? Yes No
e. Is the simulation based on a valid model? Yes No

4. Game - generally includes randomized events, provides an opportunity to "win," and presents some obstacles to "winning."

a. Is the game appropriate to your needs or objectives? Yes No
b. Is it instructional as well as diverting? Yes No
c. Is the student motivated toward learning rather than just winning? Yes No

5. Information Retrieval - information (data) is generated in the form of lists, graphs, tables, etc.

a. Is documentation easy to understand? Yes No
b. Is storage capacity adequate? Yes No
c. Is speed of operation or access adequate? Yes No

6. Utility - a support program for the counselor to generate student activities.

a. Is the utility program flexible? Yes No
b. Is it easy to use? Yes No
c. Is it well documented? Yes No

7. Management - record keeping of student performance which may be an integral part of another program or used alone as a source of diagnosis and prescription.

a. Is it easy to use? Yes No
b. Is format suitable for reporting? Yes No
c. Does it insure student privacy? Yes No

(N.B. Combinations of the types of programs listed above are common, so it may be difficult to label some programs as to specific type.)

8. Is the program free of racial/sexual, social stereo-types, inappropriate language, etc? Yes No

C. PRESENTATION

1. Purpose - Is the intended use - information returned, values clarification, decision-making, independent practice or enrichment/extension-evident? Yes No
2. Directions - Are they clear to the students? Yes No
3. Objectives - Does the student know what is to be gained by using the program? Yes No
4. Feedback - Is it effective from the students' perspective? Yes No
    a. Does the feedback vary with the performance? Yes No
    b. Does the learner get a correct answer after three or less wrong attempts? Yes No
    c. Does the feedback lead to additional learning or merely state "right" or "wrong"? Yes No
5. Display - Is the program visually appealing, attractive, readable? Yes No
6. Ease of use - Can the program be used independently with a minimum of counselor preparation or intervention? Yes No
7. User Control - Does the student have control over rate of presentation? Yes No
    a. Can the student begin the instruction at a level appropriate to his or her ability? Yes No

b. Can the student seek help from the program? Yes No

8. Theoretical Basis - Does the design reflect sound counseling theory? Yes No

9. Is the order of presentation logical and sequential? Yes No

10. Have any critical prerequisite skills been identified? Yes No

a. Is it clear what the student must know or be able to do before using the program. Yes No

11. Intended or Appropriate Audience

a. It is clear for whom the program was designed? Yes No

b. Is it clear for whom it is appropriate? Yes No

D. TECHNICAL DESIGN

1. Is the program "error free"? Yes No

2. Does the program make effective, purposeful use of color, graphics and sound, or are they used just for "show"? Yes No

3. Does the program adequately provide for misspelled words, or variations of responses? Yes No

E. SUPPORT MATERIALS

1. Are the objectives of the support materials clearly defined? Yes No

a. Do they match/complement those of the program? Yes No

2. Is it evident whether support materials are optional or required for proper use of the program? Yes No

3. Do the support materials provide the counselor with additional background, i.e., a bibliography or other resources, sample run of the program, etc? Yes No

4. Are the student materials effective, attractive, appealing, useful, etc? Yes No

F. EQUIPMENT - Have the following factors been taken into account and found acceptable or available:

1. Appropriate computer? Yes No
2. Language? Yes No
3. Memory? Yes No
4. Disk or Tape? Yes No
5. Special equipment such as a printer, light pen, paddles, joy stick, etc? Yes No

How Can Guidance Counselors Determine What Hardware To Buy?

Determining hardware is a function of (1) what kind of programs or activities are going to be carried out, and (2) how much budget is available. In addition to those two considerations, other criteria are frequently reviewed. Such things as, What else is already in use in the school?, Future expansion capability?, Maintenance cost and availability?, Software cost?, and many other concerns. To aid in the selection of hardware, the following "Computer Hardware Guideline" is provided. This Guide was adapted from one prepared by the Minnesota Educational Computing Consortium.

COMPUTER HARDWARE GUIDELINE

The challenge in selecting a microcomputer system (or any computer system) is to select a combination of programs and equipment which will meet immediate and, hopefully, future needs. This can best be accomplished by working from a set of clear goals. Currently, goals for microcomputer use will fall in four broad categories:

1. Instructional;
2. Administrative/Management;
3. Software Development;
4. Counseling/Career Development.

A. If the goal is to maximize the potential of microcomputers, planners might consider the following:

1. How many students are to be served?
2. What content will be on the microcomputer?
3. What grade levels will be included in use?
4. Will the equipment be used in individual classrooms, in a laboratory, or counseling office?
5. How have computer applications been included in the curriculum; the counseling program?

B. If the goal is to use microcomputers in administrative areas, consider:

1. Will the system be used for word processing?
2. Is inventory management or student records a likely application?
3. Is there a need to maintain budget information on the computer?
4. Is there sufficient amount of storage available?

C. Software development is a broad goal which can include many functions. Among them are original programming in a high level language, instruction, counseling applications, advanced programming for students and teachers, and development of courses using an authoring language. All of the functions which focus on the computer as the subject of instruction could be included in this area. Considerations include:

1. Is the system expandable and flexible?
2. Can different high-level languages be used, i.e., BASIC, FORTRAN, COBOL, PASCAL, LISP, FORTH, etc?
3. Is documentation available which will provide thorough access to the machine's capabilities?

D. Overall, there are general questions applicable to the three preceding areas.

1. Will the system have to accommodate more than one user at a time?
2. Would a selection that meets needs in all areas marginally be preferable to a mix of hardware that meets specific needs well?

CRITERIA FOR COMPUTER SELECTION

The following are suggested features. No one device will contain all features or meet all criteria. Your use of the computer will determine the relative importance of each.

1. Cost: Microcomputers generally range from $100-$5,000+ for a complete system. The cost most often reflects the memory capabilities, mass storage devices (i.e., disc drives), and flexibility of the system.
2. Portability: In assessing portability of a system, the following should be considered:
   - * Is weight excessive or can a utility cart be employed?
   - * Are special environmental considerations (humidity, dust, temperature) a problem?
   - * How much disconnection of components must be done before moving?
   - * Can the system work reliably when moved frequently?
3. Mainframe Interface: Can the unit be interfaced with available time sharing systems to function as a smart terminal (i.e., through a communication card, serial card, modem)?
4. Keyboard Layout: There are, unfortunately, no standards for computer keyboards, although most are similar to a typewriter. Among the variations are size, number, and placement of keys and special key functions. Several computer keyboards also include special numeric key locations to be used in calculation activities.

   If at least 50% of usage will involve calculation activities, a keyboard with an auxiliary numeric key pad should be considered.

(Numeric key pads are available as attachments at an approximate cost of $80+$250 depending upon functions.)

5. Additional Ports: Ports are connections or "plugs" which connect the computer to other equipment such as: numeric key pads, modulators, printers, paddles, etc. Ports may be referred to as I/O ports or input/output ports. Where are the ports located? How accessible are they? If ports are located in an inconvenient place requiring that the system be constantly dismantled--perhaps another system should be considered.

6. Memory Capacity Considerations: Memory comes in two forms:

   RAM (Random Access Memory)
   ROM (Read Only Memory)

   RAM is used for workspace in the computer, for temporary storage of programs, calculations, results. The amount of RAM determines the maximum size of programs the computer can accommodate. The minimum useful RAM is about 8 thousand characters (8K) while the preferable amount for most applications is from 48K to 64K.

   ROM is useful for storing programs that are used frequently such as BASIC language. This memory is generally programmed by the manufacturer into an integrated circuit chip. The program is stored permanently in the chip. The computer can read the memory but cannot change it. Programs in this form are frequently called firmware.

   a. Is sufficient RAM provided to operate the software you have chosen?
   b. Can RAM be expanded?
   c. Are frequently used programs available in ROM (Read Only Memory)?
   d. Can ROM be expanded?
   e. Are costs for RAM and ROM expansion within reason?

7. Input/Output Devices: In reviewing the input/output devices, one must determine the capability of such devices.

a. What type of printers are compatible with the system?
b. Is a monitor built in or separate?
c. Must a monitor be used or is a standard t.v. adequate?
d. Are disk drives built in or separate?
e. How many disk drives can system access?
f. Is the system compatible with a hard disk drive for mass storage capabilities? What provisions are available for hard disk back-up?
g. What types of other peripherals are compatible with the system? (Graphic tablet, synthesizers, light pens, etc.)
h. Can system be connected to a video tape recorder (VTR) or a video disk player?

8. Video Display: Video displays may be integrated into the computer or attached as a separate unit.

a. How many characters available per line on video output? (Video display in most cases is either 40 to 80 characters. 80 characters recommended for word processing, data management, software.)
b. What character sets are available? (Size of text, upper and lower case, upper case only, graphics characters.)
c. Is the system capable of displaying low or high resolution graphics?
d. Is the system capable of generating color?

9. Sound Generation: In reviewing sound generation qualities, the following criteria should be considered:

a. Are there internal or external speakers with the system?

b. Can additional external speakers or music boards be added to the system easily?

c. Is the tone or pitch range quality adequate for music generation?

d. Can system be adapted to voice command or generation with auxiliary peripherals?

10. Documentation: Documentation and support services from the manufacturer or distributor are of great importance in making a final selection. In reviewing materials, the following criteria should be considered:

    a. Are there sufficient manuals and support materials for system?

    b. Is the content well presented and easily understood?

    c. Are diagrams and step-by-step instructions included?

    d. Is the manufacturer/distributor willing or able to answer questions on the phone?

11. Servicing: Service and repair of equipment is another vital concern. Often servicing criteria are overlooked at the time of purchase and can cause some unnecessary hardships later. For this reason, the following should be considered:

    a. What type of warranties are available?

    b. What do the warranties include-parts, labor, shipping, etc.?

    c. Can school district technical staff be trained to service equipment?

    d. Are training sessions available from manufacturer?

    e. Is training included with purchase or is it available at additional cost?

    If product must be serviced outside school district, the following should be considered:

a. Is on-site service contract available? What are the costs, terms, etc.?

b. Is the service center local or remote from the district?

c. Are shipping costs covered?

d. What is average turn-around time for repair and delivery?

e. Are replacement parts readily available?

f. Is a loan program available so lost-time can be reduced?

After reviewing the criteria for computer selection, the next logical step is to examine video displays and printers.

Peripherals are often more difficult to evaluate and select than computers.

Manufacturers are constantly producing new peripherals and the number of variations in standard video displays and printers is astounding. In selecting peripherals, one should make sure that the peripherals are compatible with a particular computer selection and provide the features required for special software applications.

CRITERIA FOR VIDEO DISPLAY SELECTION

1. Terminology: Video displays generally range from $75-$1,000. The cost generally will indicate: size of screen, black/white vs. color, resolution of screen display for text clarity, color and graphics.

   Several types of video displays can be used in computer application. One source of confusion is the use of terms video monitor, video display or video terminal. All refer to a type of video display for a computer but each has its own special features.

   Video monitor: similar to a television set, but differs from a standard television in that it cannot receive signals over the air.

   Video display: the general term that indicates a device to display video signals from a computer system.

Video terminal: a video monitor equipped with a keyboard and logic circuits for display of characters and graphic information.

2. Alternative Displays:

   A. A regular black and white television receiver may be used as a video display. Some computers require an external RF (radio frequency) modulator. An RF modulator is a device that costs approximately $40 and is connected to an I/O port in the computer and the antenna terminals of the television. A modulator will temporarily convert a standard television into a computer display. Although an RF modulator is an inexpensive alternative to a black and white or color video monitor, the following should be considered:

      * If a computer application requires the user to read extensive text, a video monitor should be considered. The reason being that the screen resolution is somewhat distorted with an RF modulator. Text can become blurry and shadowed, which will cause unnecessary eyestrain to the user. Readability and clarity of text is not as sharp as other video display alternatives. Check to see that radiation levels from the screen are not excessive.

   B. The next economical alternative is the use of a black and white or green-phosphorus screen video monitor. Average cost for display of this type is approximately $150. Cost will range from $125-$350 depending on size of screen and resolution characteristics.

      Green-phosphorus monitors are generally preferred over black and white for their high quality text display, visual clarity and reduced eye strain.

C. Color monitors range from $400-$1,000. The average cost is approximately $450, again depending upon resolution characteristics, size of screen, etc.

Color monitors provide better high-quality color definition than a regular television receiver. They are particularly useful in color graphics displays. Color monitors are not recommended for a great deal of text work (i.e., business applications, word processing) because of color diffusion and text overlap. For this reason, color monitors are not well suited to 80 character line display.

3. Flexibility/Portability: If a video display unit is not built into the computer system, consider:

   * Weight of video display device.
   * What type of video connectors are required?
   * Size of screen available - 9"-25".
   * Are handles available for transportation?
   * Are auxiliary input and output connections available so additional monitors can be chained to a single computer?

4. Accessibility of Controls: Location of the various video controls should be reviewed.

   a. Are the vertical and horizontal controls easily accessible?
   b. If controls are located on rear of video display are they clearly marked, easy to adjust, etc. (Several companies require a special tool or screwdriver to adjust controls on the rear panel.)
   c. If controls are located on front of system, is a special door or cover available to hide controls when not in use?
   d. What type of power switch is available?
      * If a pull on switch is available, is the knob securely fastened?

e. Is a pilot lamp or power-on signal light provided?

CRITERIA FOR PRINTER SELECTION

There is a bewildering variety of printers on the market each with different features, speeds and interface provisions. But for microcomputer use, there are essentially two fundamental methods for creating letter or graphic symbols on paper. Most familiar is the adaptation and development of high quality typewriters. Letters are made by a ball or wheel element which strikes ribbon and paper to produce a clear, fully formed character. Less costly is the dot matrix printer. Characters are formed by closely spaced dots. While the characters are easily recognizable and sometimes approach the quality of fully formed characters, only a few dot matrix printers are of correspondence quality. Printers cost from $300 to $5,000. The lowest cost letter quality printer begins at about $1,600. This price has been gradually coming down and may approach the cost of a quality electric typewriter in the future.

1. Portability: In assessing portability of printer, the following should be considered:
   a. Weight.
   b. Size.
   c. Special environmental considerations (humidity, dust, etc.).
   d. Can the printer withstand frequent movement or transporting?
   e. How much disconnection of cables must be done before transporting?
2. Computer Interface:
   a. What type of computer interface card is needed? Serial or parallel? Special card developed by printer company?
   b. What auxiliary cords are needed for computer connection? (RS232, etc.)
3. Paper: In reviewing printers, type of paper, size, and method of paper advance and entry, are important factors to consider. For example, if the printer is used heavily, the higher cost of thermal

paper may result in higher long-term costs than if a more expensive printer had been purchased.

   a. Thermal paper, sprocket fed, regular paper.
   b. Cost of paper - (bulk quantities).
   c. Size of paper - 40, 80 or 132 column.
   d. Can printer print on pressure sensitive labels?
   e. Maximum thickness of paper accepted (suggested paper weight).

4. Friction-fed printers allow the user to print on letterheads, forms, ditto masters, and regular bond paper. This option is helpful for word-processing operations. This type of operation is slower than sprocket-fed printers and causes some inconvenience to the user.

   Sprocket (tractor)-fed paper is moved by advancing the printer sprockets into corresponding holes in the paper. This method assures proper alignment. The operation is very fast and, once the printer begins, no user interaction is required. Tear-away-edge on the sprocket-fed paper is recommended when output will be photocopied.

   a. Is sprocket feed only provided?
   b. Is friction feed only provided?
   c. Does the printer accept friction and sprocket fed paper? (This type is recommended for the versatility provided.)
   d. How is paper fed into machine?
      1. Bottom feed (requires special stand).
      2. Front or rear feed (front feed convenient for single sheets).
      3. How is paper positioned? Automatic paper-feed vs. manual?

5. Speed of Printer:

   Printer refers to the number of seconds it takes to print a group of characters. This rate is expressed in characters per second (CPS). Common speeds are 10, 15, 30, 45, 55, 135 and 225 CPS.

   In general, dot-matrix printers are faster than letter-quality printers. If letter-quality is not an important factor, a dot-matrix printer is a good choice for fast, efficient, and reliable printing.

6. Character Sets - Fonts: In determining quality of character sets, the below questions should be reviewed.

   a. Is character spacing variable or fixed? What are the variable spacings?
   b. Is the density of dots forming characters low, medium or high?
   c. Are block or double-width characters available?
   d. Is there a double-strike feature for emphasis of headings or titles?

   Fonts refer to the variety of type sets available in a printer. The more fonts available, the more versatile the printer will be. Various fonts available are listed below:

   a. Upper case.
   b. Lower case.
   c. Condensed.
   d. Double width.
   e. Reverse (white on black)
   f. Roman, Gothic, Italics, etc.
   g. Block graphics, fine line graphics.
   h. Foreign language symbols, mathematical symbols.

   Another feature of the higher quality printers is the storage of alternate character sets in ROM (Read Only Memory). Some printers allow the user to define their own character sets.

7. Operator Control: Operator control refers to the functions of the printer that can be specified by the user. All printers have switches that must be set to determine the printer's functions. In reviewing switch controls, consider the following:

   a. Where are switches located? (Several printers have the switches inside which forces the user to remove covers to change the switch settings. Others are located on the back, front or side. The font-and side-mounted switches are the most convenient for the user.)

b. Is line-spacing selectable?

c. Are selectable margin settings provided?

d. Is font selection character set selectable?

e. Are various computer-to-printer communication rates provided? (Called band rate.)

f. Is an on line/off line indicator switch provided?

g. Is there self-test function? (Several printers include a self-test function which allows you to test the internal switches that you have set in the system.)

h. Can form switch be set? (Lets the user define the top paper for print entry for fan-fold tractor-fed operation.)

i. Does form feed advance paper to next top of form setting automatically?

j. Does line feed allow user to automatically adjust paper one line at a time?

k. Is manual form alignment possible? (Several printers only have automatic alignment features. Manual adjustments enable the user to control paper as in a typewriter.)

Switch operation and function will vary within the types of printers available. The more expensive the printer, the more versatile are the switch selection and font characteristics. A function which has not been emphasized is the graphics capability of the system. Graphics are often available for printers as an extra cost option. The size of the character matrix will determine the quality of the graphics output. Recently, a few printer manufacturers have announced the option of color print for graphic generation or plotting.

Additional considerations for printer selections should be based on adequate documentation and service contracts. Clear and concise documentation is essential to make full use of printer capabilities provided. In reviewing documentation, a quick reference card for printer switch adjustment and function is a welcome extra.

Service contracts should be a major concern of the user. Printers have more mechanical parts than other microcomputer peripherals and may require service before the rest of the system.

What Are The Professional And Ethical Issues Covering The Use of Micrcomputer Managed Career Information Systems?

Since computers make it possible to store and retrieve large amounts of information and since computer storage is becoming very inexpensive, it is possible to obtain, store, and access large amounts of confidential data. Unauthorized or accidental access is always a possibility. A second concern is that the use of a computer greatly expands the scope and content of information which is provided to a student. This raises the possibility of decisions being made based on inaccurate data should a system contain such data. Likewise, as more software programs are utilized, what responsibility does the counselor have for the career decisions which students make or fail to make?

These professional and ethical questions were discussed and a set of ethical principles set forth in an article presented in The Personnel and Guidance Journal (Sampson, January, 1983, pp. 283-287).

The following is a list of the principles which should be considered when selecting an operating career information system.

1. Ensure that confidential data maintained on a computer are limited to information that is appropriate and necessary for the services being provided.

2. Ensure that confidential data maintained on a computer are destroyed after it is determined that the information is no longer of any value in providing services.

3. Ensure that confidential data maintained on a computer are accurate and complete.

4. Ensure that access to confidential data is restricted to appropriate professionals by using the best computer security methods available.

5. Ensure that it is not possible to identify, with any particular individual, confidential data maintained in a computerized data bank that is accessible through a computer network.

6. Ensure that research participation release forms are completed by any individual who has automatically collected individually identifiable data as a result of using a computer-assisted counseling, testing, or guidance system.

7. Ensure that computer-controlled test scoring equipment and programs function properly thereby providing individuals with accurate test results.

8. Ensure that generalized interpretations of test results presented by microcomputer-controlled audiovisual devices accurately reflect the intention of the test author.

9. Ensure that a client's needs are assessed to determine if using a particular system is appropriate before using a computer-assisted counseling, testing, or guidance system.

10. Ensure that an introduction to using a computer-assisted counseling, testing, and guidance system is available to reduce possible anxiety concerning the system, misconceptions about the role of the computer, and misunderstandings about basic concepts or the operation of the system.

11. Ensure that a follow-up activity to using a computer-assisted counseling, testing, and guidance system is available to correct possible misconceptions, misunderstandings, or inappropriate use as well as assess subsequent needs of the client.

12. Ensure that the information contained in a computer-assisted career counseling and guidance system is accurate and up-to-date.

13. Ensure that the equipment and programs that operate a computer-assisted counseling, testing, and guidance system function properly.

14. Determining the need for counselor intervention depends on the likelihood that the client would experience difficulties that would, in turn, limit the effectiveness of the system or otherwise exacerbate the client's problem.

In summary, the microcomputer is to stay in the guidance department and/or the career center. Applications will greatly increase over the next several years to a point where it will be as common as the Occupational Outlook Handbook in most guidance centers. Computers will be the counselor aids of the 80's. Choosing good software and hardware is the major task ahead for most counseling departments. Beyond that will be the application of this software and hardware in terms of effective and efficient use. Ultimately, counseling will be improved as a result of microcomputer technology. To provide additional background in this area, a reprint of the American Vocational Association Division Newsletter, Volume 9, Number 2, August, 1982, entitled, "Career Information Resources in Secondary Schools" follows. In this Newsletter, key leaders discuss the results of the NIE funded study of Career Information Resources and provides a number of recommendations for the future.

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Career Information Resources in Secondary Schools

In August 1981, the AVA Guidance Division received funding from the National Institute of Education (NIE) for interpreting and disseminating findings of an Educational Testing Service (ETS) national survey of career information resources in secondary schools for vocational guidance personnel. The survey was commissioned by the National Occupational Information Coordinating Committee (NOICC) and monitored by NIE. The study sought to answer the following questions: (1) What career information is being disseminated to secondary school students? (2) How is it being provided? (3) What is the quality of such information? (4) What is its value to students?

The purpose of this special edition is to report the interpretations and suggestions of the data collected from this research to the membership; to identify implications for career guidance programs, practitioners, and settings; and to recommend ways to improve the delivery of career information to students in secondary schools.

BACKGROUND AND DESIGN OF STUDY

The ETS study researched the following basic areas: types and quality of career information resources; management of and access to career information resources; and use and quality of additional (nonschool) career information resources.

The responses were gathered via sample survey of both school and student populations and separate analyses of career information were compiled.

A questionnaire entitled *Career Information Systems in Secondary Schools: A National Survey of Occupational Information Resources* was developed; answers were obtained from a nationwide random sample of approximately 10 percent of all public schools (1,894) with grades 10, 11, and 12. The questionnaire was sent to the principal of each school, however, the questionnaire was usually completed by a school administrator or the director of guidance.

Data from a concurrent sample of 4,882 students in a subset of 155 of the schools surveyed were collected; the questionnaire developed for use with students was entitled *Learning about Occupations: A National Study of High School Students*.

In a follow-up analysis of sampling methods used to obtain student responses to the questionnaire, ETS researchers determined that over 20 percent of the schools used nonrandom procedures to select students. Therefore, in this newsletter, an asterisk (*) indicates findings from the student sample.

AVA Guidance Division agrees with the ETS researchers that the responses from students may not be a true representation of all students in the sample frame because some schools did not select students randomly. The extent of nonrandom selection is not known, nor is the direction or amount of bias introduced by it. The data can be treated as responses of a large number of students (4,882) from all regions of the nation; the results are still informative and useful.

Figures are based upon the percentage of those responding; for brevity, often only key percentages are reported. Figures reported will occasionally total more than 100, because the questionnaire item allowed the respondent to select more than one choice as an answer.

To obtain the ETS documents or the Executive Summary reporting the results of these studies, see page 10.

AVA GUIDANCE DIVISION'S DISSEMINATION PROJECT

To review, interpret, and disseminate the research findings from the ETS study, the Guidance Division appointed a task force comprised of Janet Treichel — chairperson (University of Illinois at Urbana-Champaign), Dale Ake (Florida State Department of Education), and Juliet Miller (National Center for Research in Vocational Education, Ohio State University). This task force reduced the original 400-page ETS report to a set of seventy-four results statements and circulated them among thirty-nine field reviewers. The field reviewers' task was to: (1) suggest causes for the findings; (2) identify implications of the findings for career guidance programs, practitioners, and settings; and (3) make recommendations for ways to improve career information resources in secondary schools. The results' statements and field reviewers' comments which were synthesized by five authors are presented below for the membership's review.

SUMMARY RECOMMENDATIONS

A summary set of recommendations for policymakers, trainers, administrators/managers, and practitioners/program and service providers drawn from the research is as follows:

Policy (Policymakers)

1. Career guidance programs help students develop skill in life career planning, and should be viewed as curriculum areas of equal importance to other major educational areas.
2. Collecting, organizing, and disseminating career information should be supported by centralized national/state activities.
3. Computer literacy training for guidance personnel should become a federal, state, and local priority.
4. The federal government has supported the development of competency-based training programs and career information delivery systems. These efforts have been important in upgrading this field of education. Funding should be provided for disseminating and updating existing programs and systems.
5. Policymakers and change agent personnel concerned and responsible for assisting students in career development planning should concentrate their efforts on various state agencies' policies that affect the delivery of career guidance and career information programs and services.

6. Professional associations, such as the AVA Guidance Division and the National Vocational Guidance Association, should have input on national policy related to career guidance and career information.
7. Policymakers should communicate students' career guidance and information needs to state and federal legislative personnel to ensure adequate financing.
8. Local school boards and administrators should be educated to the career development needs of students and the resources available for them.

Training (Trainers)

1. Specific competencies should be adopted as the basis for developing and upgrading programs to improve counselors' career guidance/career information delivery skills such as the competencies recently adopted by the National Vocational Guidance Association.
2. Counselor preparation programs and professional development programs must be expanded to include strong career development components, including career information resources, experiential programs/activities, career couseling practicums, and computer literacy.
3. Counselor educators should be involved in the delivery of both preservice and inservice training programs.
4. Counselor educators should review and update curriculum to incorporate new developments such as career resource centers and career information delivery systems.
5. Trainers should be able to provide staff development training for career guidance personnel. Trainers should provide technical assistance to practitioners on the selection, organization, and use of career information.

Administration/Management (Administrators/Managers)

1. Comprehensive career guidance programs result in a revised counselor role which includes cooperation with teachers, program planning and management, and increased career planning assistance. Administrators need to appreciate the implications of this change in role and relieve counselors of other duties.
2. Career information materials become outdated and must be reviewed and replaced. An adequate budget and appropriate staff time need to be allocated for this.
3. Administrators should recognize the importance of community resources and input and place more emphasis on them.
4. Administrators should arrange inservice activities on computer literacy for guidance personnel.
5. Personnel responsible for the delivery of career guidance and career information programs should be required to develop comprehensive programs that contain good management plans. Budgets should be determined and based on this management plan; proper evaluation of the effectiveness of staff and program goals must be determined. Administrators may need to become more informed and sensitive to the social impact of students' career development needs and the current lack of efforts to meet those needs.

Service Delivery (Practitioners/Program and Service Providers)

1. Because of new developments in career guidance/career information, practitioners need to upgrade their skills.
2. Recognizing that comprehensive career guidance requires teaming within the school and across institutions, practitioners need to cooperate and develop effective teams.
3. Guidance personnel should participate in inservice activities to improve their computer literacy.
4. Peer counseling career information activities should be devised to take advantage of the student telegraph and hotline.
5. Comprehensive programs and new guidance strategies result in new roles for practitioners. Practitioners need to examine their new roles and seek training when necessary to help them feel comfortable with them.
6. Practitioners need to develop strategies to raise the level of consciousness of parents and teachers on the importance and role of career guidance personnel and programs.
7. Effective strategies for communicating with administrators and boards of education to gain program support must be developed. Programs should be based on student needs and on data supporting program effectiveness. Practitioners need to understand the fiscal planning process.

CAREER INFORMATION RESOURCES: TYPES AND CONTENT

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University of Illinois at Urbana-Champaign

Research Question: What are the types of career information resources currently available in secondary schools and what kinds of information do these resources contain?

Major Findings:

1. The majority of the nation's schools, small, urban or rural, use bound reference publications more than any other type of career resource. Most used are the *Occupational Outlook Handbook (OOH)* and the *Dictionary of Occupational Titles (DOT)*. Other popular resources are school-arranged experiences and occupational briefs and kits.
2. Rural schools are less likely than urban schools to have or use a variety of resources in their guidance programs.
3. Computerized systems are the most comprehensive career information resource. Publications such as *Chronicle Guidance*, *SRA Briefs*, and the *Occupational Outlook Handbook* are the most comprehensive print resources.
4. Computerized and microform career guidance systems are the best sources of regional information. Computer systems usually provide means for identifying occupations that meet a number of specifications imposed by the user.
5. Most schools use simulations, computerized systems, and noncomputerized sorting kits and materials less frequently than other resources.

Suggested Causes and Implications:

Public school personnel lack knowledge of existing and improved career guidance resources and delivery systems. This seems to result from several factors: (1) public educators are bound by tradition, (2) limited fiscal resources restrict the acquisition of new resources, and (3) exposure to new systems and technologies is limited. Counselors do not receive adequate preparation and training about career information resources. Counselors appear to have a lack of imagination and interest in investigating new resources and delivery modes. Thus, there is great reliance on limited and often outdated career information resources and system.

Counselors often rely on limited and outdated resources for career information. Without new professional development experiences, counselors will continue to use limited resources.

Economics continues to be a critical determinant of the resources used. Bound reference publications and occupational briefs and kits are generally within a price range considered reasonable by most school administrators. Most guidance departments operate without a budget so the cost-effectiveness of new purchases becomes an important consideration. Other factors that contribute to the high incidence of selection and use of bound reference publications centers on the assumed completeness and accuracy of the materials, low maintenance requirements for guidance personnel, and a relative lack of supervision needed for student use.

Where computerized systems have been fully implemented, they have demonstrated efficiency and effectiveness in providing a greater range of delivery and utility options. Computerized systems do not appear in many schools for two major reasons: expense and discomfort with these new technologies. However, when career guidance personnel understand these systems more thoroughly and realize their capabilities for delivering current and regionally relevant career information, changes should occur.

Recommendations:

1. Federal and state leadership as well as local school administrators need to recognize the importance of a comprehensive career guidance program for students; they need to identify strategies to make it possible for all schools to acquire effective, up-to-date information delivery systems.
2. Counselor preparation programs should revise and update vocational and career counseling courses.
3. Linkages between the educational community and the business industry/labor community should be strengthened to increase opportunities for guidance and counseling personnel to visit local businesses and industries. Such visits would help counselors to (1) more effectively use them as career information resources; (2) facilitate communication and enhance cooperative planning and implementing of career guidance information delivery systems; and (3) support school expenditures for career and occupational information systems.
4. State and local education agencies and professional organizations should provide school personnel with more information and training opportunities for learning about different types of resources and systems. They should address: effectiveness, access and usability, and application to and incorporation into the academic curriculum.
5. Federal and state agencies should continue to develop and disseminate career and labor market information as well as information on future trends and needs. Such agencies should also continue to emphasize the marketing of information and systems to the local educational agencies as well as assist schools in their decisions and purchases of comprehensive systems of career information.

CAREER GUIDANCE AND INFORMATION: WHO IS RESPONSIBLE?

Dr. Juliet Miller
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The Ohio State University

Research Question A: Who is responsible for career guidance management and who is responsible for specific management tasks related to career information?

Major Findings:

1. Almost two-thirds (63 percent) of the schools had an individual who served as director or head of career guidance; about one-third of the schools distributed career management activities among several staff members.
2. Career information management activities most often rested with the director/staff for guidance. They had responsibility for: evaluating new or replacing career information materials (51 percent); helping students locate materials or advising them about where to look (64 percent); arranging special career information programs, events, or days (59 percent); making data on jobs held by former students available to current students (33 percent); deciding when to discard obsolete materials (57 percent); maintaining indexes of occupational information materials (55 percent); and coordinating activities with external agencies (63 percent). Only one activity, supervising exploratory work-experience programs, involved other school personnel (teachers) to a greater extent than guidance personnel; administrators were rated as having equal involvement as guidance personnel in financial planning for career resources.

Suggested Causes and Implications:

Career information management is a recognized guidance function in many schools. This is consistent with traditional views of guidance. More recently, this responsibility has been shared with career education coordinators/staff. There is a tendency for the specific management tasks related to career information to be spread among staff, including guidance personnel, school administrators, and librarians/media specialists. This is appropriate since career information management tasks overlap with other traditional responsibilities, such as planning and financial management responsibilities of administrators and the information acquisitions and management responsibilities of librarians. Clearly identified leadership in the career information area is needed. It is important for one individual, such as the director of guidance, to coordinate management tasks related to career information.

The trend of reduced funding for education has influenced the management of career information by reducing the funds available for staff and for the purchase of career information resources. Many staff are being assigned multiple responsibilities or are being assigned to new responsibilities, and administrators are often confronted with increasingly difficult budget decisions. In the past, funds for purchasing career information materials have come from Title IV-B, which is administered by administrators and librarians rather than guidance personnel.

It is not surprising to find differences among schools in career information management patterns. Not all schools have a director of guidance; staff tend to assume responsibilities according to interest and career education coordinators have often assumed responsibility for coordinating career information resources. To achieve the goals of these programs, it is crucial to have a coordinated approach to career guidance and to the role of career information resources. The guidance director staff need to have an acknowledged role to coordinate activities in the career information area. Guidance staff need to review their understanding of the importance of career information and to assume a leadership role in communicating the importance of career information to other school personnel.

Recommendations:

1. Guidance personnel need to renew their career information management skills. New career information systems and career resource centers should be reviewed. The guidance staff needs to appreciate the unique contributions that administrators, librarians, teachers, and students can make to the management of career information. The guidance staff should assume leadership in this area. They should view their role as coordinating the efforts of many.
2. There continues to be a need to communicate with boards of education and school administrators about the contribution which career guidance can make to student motivation, achievement, and retention. Studies evaluating the impact of career information services need to be conducted and the results should be presented to decision makers. Because of limited financial resources, schools are facing difficult decisions and need information to make decisions. Guidance personnel need to understand the budget and to provide input at appropriate times. Budget requests need to include well-documented support for career information requests.
3. There is a need for state and local career information. Establishing and updating such information requires time and resources. Schools need to form networks with other agencies and professional associations for the development and sharing of these local information resources. Because of limited school budgets, it is crucial for guidance personnel to increase cooperative arrangements with and seek funds from business, industry, and labor groups.

Research Question B: What career information activities are performed by professional counselors (state certificate in guidance)?

Major Findings:

1. Counselors are involved in career information activities such as directing students to books, pamphlets, films, or other sources of occupational information; answering students' questions about occupational information; interpreting occupational information obtained by students; and assisting students with career decisions after they have used occupational information resources.
2. Counselors spend about the same amount of time in each of these activities.

Suggested Causes and Implications:

Counselors interpret occupational information and help students with career decisions. Students tend to seek counselor help when confronted with a specific decision or need for information. Counselors, because of their traditional roles, time schedules, caseloads, and comfort with existing skills, tend to continue to respond to student requests rather than to design and implement more comprehensive career guidance procedures which utilize the total resources of the school.

Recommendations:

1. The results of this national survey indicate that more comprehensive career guidance strategies are being used but that school guidance staff still need assistance in moving toward the adoption of comprehensive, systematic career guidance programs. Massive efforts to develop models for such career guidance programs have been made during the last decade through the activities of professional associations and state departments of education. These program models are available and, in many states, have been disseminated through comprehensive training activities. It is important to continue to announce the availability of these materials and to provide both pre- and inservice training on their use.
2. Counselors face the dilemma of functioning in traditional ways with limited time for program development. New program models suggest alternatives which can free counselor time for assisting students in the development of career planning skills. In general, these models propose more diversified guidance strategies including the development of career resource centers, the use of self-instructions in career information materials including computer-based and/or microfilm career information systems, classroom career guidance activities, group counseling activities, coordinated staffing patterns, and individual counseling activities.
3. Increased numbers of self-directed materials are available which will reduce the level of counselor assistance required and free their time for other career planning assistance activities. Also, judgments about specific career guidance strategies should be made based on local student data indicating career planning needs, satisfaction with current services, and success in post high school career experiences.

Research Question C: How do schools manage the process of reviewing career information?

Major Findings:

1. Seventy-three percent of all the schools do not have a formal committee to screen for obsolete career information resources; rather, it is done by one person.
2. There are many sources which schools can use to identify and select career information. Most schools reported using more than one source of such information. The sources named by the greatest percentage of schools were (1) publisher's catalogs (66 percent); (2) *Career Index* (51 percent); (3) *Educator's Guide to Free Guidance Materials* (50 percent); (4) *Career Guidance Index* (46 percent); and (5) *Guide to Local Occupational Information* (28 percent) and the *Vocational Guidance Quarterly* (28 percent).
3. Of the sources developed by the National Vocational Guidance Association to assist in the selection of career information, 28 percent of the schools used the *Vocational Guidance Quarterly* and 3 percent used the *Bibliography of Current Career Information.*
4. About 50 percent of the schools review career information materials once a year; 25 percent review them less than once a year; 10 percent review them more than once a year; 5 percent indicated they "never" perform this task, and 10 percent "did not know" or did not respond.

Suggested Causes and Implications:

Career information differs from other types of information purchased by schools because it directly influences the life decisions of students. If such information is inaccurate, obsolete, or biased, it can have a detrimental effect on the lives of students. Many school staff who have career information management responsibilities, such as administrators and librarians, may not be fully aware of these dangers. In times of limited financial resources, there may be a hesitancy to remove materials or to allocate staff time for a frequent review. It is tempting to make purchase decisions on cost alone, thus favoring free and inexpensive materials. Another problem is a lack of awareness of information sources that can aid in identifying and evaluating the quality of career information. A final consideration is the need for national, state, and local information. While there are services which provide listings of national information, there are fewer resources for state and local career information.

Recommendations:

1. Both professional associations and state agencies provide materials that can help schools identify, evaluate, select, and update career information. The National Vocational Guidance Association has guidelines for evaluating career information and members donate their time to review career information. Associations involved in these activities need to communicate the availability of resources not only to their members but to school administrators and librarians.
2. Through the National Occupational Information Coordinating Committee (NOICC) and the State Occupational Information Coordinating Committees (SOICC), major progress has been made in developing state and local career information, in providing comprehensive career information systems that are updated at the state level, and in making these systems available in computer and microfiche versions that are less expensive to update on a yearly basis. This highlights the need to move toward centralizing the organization and management of career information resources.
3. Counselors should review resources and select them on the basis of specific program goals. They need to teach students how to evaluate career information and how to identify outdated information.

STUDENT ACCESS TO CAREER INFORMATION RESOURCES

Dr. Evelyn Lavaty
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Nebraska State Department of Education

Research Question A: What arrangements have schools made to provide students with access to publications and experimental programs?

Major Findings:

1. Management responsibilities for helping students locate career information were delegated to the guidance director/staff in 64 percent of the reporting schools. The career coordinator and staff shared the responsibility in 15 percent of the schools and librarians provided career information in 13 percent of the schools. Teachers (7 percent) provided the least information. However, over 90 percent of the schools indicated that students were directed to both general and specific career information resources by professional counselors.
2. The six top-ranked methods used by schools to file career information resources were the following: (1) alphabetical by title of occupation, (2) *Dictionary of Occupational Titles* code, (3) type or level of education or training, (4) interest fields, (5) Dewey decimal system, and (6) type of industry or employer.
3. The guidance director/staff had the responsibility for maintaining an index of career education materials in 55 percent of the schools. The career education coordinator/staff maintained an index in 15 percent of the schools and the librarian provided the service in 19 percent of the sites. About 70 percent of the schools do not have a central index to locate all information about a specific occupation.
4. The *Occupational Outlook Handbook* was the most commonly used resource of occupational information. It is interesting to note that multiple copies (five or more) were available in only 19 percent of the schools. Twenty-two percent of the schools had only one copy, 19 percent had two copies, and 6 percent had four copies. Nonmetropolitan schools were apt to have fewer copies.
5. Management responsibility for arranging experiential programs was assigned to the guidance director and staff in 59 percent of the schools. This included arranging special programs and events. The coordinator/staff for career education had the task in 16 percent of the schools and the principal assumed the responsibility in 15 percent of the schools. The supervision of exploratory work-experience was assigned to teachers in 25 percent of the schools. The guidance director/staff assumed this responsibility in 23 percent of the schools and career education staff assumed the task in 14 percent of the schools.
6. The most commonly used methods to inform students about experiential programs were (by rank order): (1) conferences with counselors (76 percent), (2) presentations to the student body (52 percent), (3) lists of course offerings (40 percent), (4) recommendations by teachers (30 percent), and (5) presentation to parents (21 percent).
7. Reported follow-up most frequently used to help students relate information to career decision making were (by rank order): (1) conferences with a counselor or teacher (56 percent), (2) group discussion (34 percent, (3) written student reports (29 percent), (4) oral student reports (27 percent), and (5) test or questionnaire (23 percent).

Suggested Causes and Implications:

In most instances, the routine training of guidance counselors has not included emphasis on career information delivery; yet 90 percent of the schools indicated that students were directed to career information resources by professional counselors. This would suggest that all counselors should have career information as an integral part of their professional training. It is noted that in some schools the responsibility for helping students locate career information rested with career education staff, librarians, and teachers.

Many schools have not made career education a priority and therefore have not assigned the responsibility for the delivery of career information. Preparation for work has not been accepted as an objective or role outside of the "categorical" vocational curricula. Responsibility for arranging experiential programs has probably been determined by the interests of available staff. When career development is everyone's general responsibility and not one person's specific responsibility, programs tend to become erratic, nonfocused, and/or inadequate. Methods used to inform students of experiential programs lack the focus needed to ensure that all students are informed because these programs have not been highly valued by many administrators and staff.

The study did not provide data about the percentage of schools providing structured follow-up activities. Most counselors have not been involved in a follow-up process to help students process and internalize the activities they have experienced. Structured follow up of students is relatively rare.

The *Occupational Outlook Handbook* is well advertised, easily available, and has been in school libraries for many years. It provides a structure that is comfortable for many counselors who have no structure of their own, and its organization and completeness of data help counselors *sound* more knowledgeable than they probably are. Nonmetropolitan schools are more apt to look at occupations in terms of the narrower interests and opportunities in their immediate communities and would not use the *OOH* as frequently.

Seventy percent of the schools who do not have a central career index are a result of the random, unplanned way in which resources are acquired. Lack of uniformity in filing career information resources may also be due, in part, to the fact that there is not one accepted model. In all likelihood, the career guidance staff is responsible for maintaining an index of career information materials because such materials are used more frequently in the guidance office or career center than in a library. Data suggests this is by accident rather than by systematic planning.

Recommendations:

1. Counselors need the skills required to direct students to appropriate career resources and assist them in using these resources.
2. The impact of accessibility and use of career information on career choice, job seeking/getting/maintaining/mobility, job success, and job satisfaction must be determined. Dissemination of this data to school boards and school staff will encourage the assignment of specialists to the job of providing career information.
3. Leadership in the development of efficient and effective career information systems should be assumed by the professional associations representing counselors and career and vocational educators.
4. Every school should have an experiential program with one person designated as coordinator. This person should have the responsibility of designing, implementing, and evaluating experiential activities. Informing students about experiential programs should be an ongoing, regular communication with *all* students in the regular classroom. Work experiences should be keyed to occupational preferences and education/training plans. No school experience is complete without planned follow up. Providers of activities must design feasible and effective follow-up procedures.
5. A central index of career information should be maintained in every school. The career information specialist, with the help of the librarian, should use the *OOH* as a model for organizing the career index.

Research Question B: What arrangements have schools made to provide students with access to computerized systems and audiovisual, microfiche, and noncomputerized sorting materials?

Major Findings:

1. In schools having computerized systems, a student could request access in over 80 percent of the sites. Students were assigned access by counselors at about 70 percent of the sites; teachers were assigned access at about 50 percent of the sites.
2. In schools having computerized systems, student access was influenced by the number of terminals. The majority of schools reported having one or two terminals for student use. Terminals were used less than half (46 percent) of the available time.
3. In schools that have terminals, staff involved in helping students use a computer included counselors in 50 percent of the schools, a secretary in 19 percent of the schools, and an unspecified person in 38 percent of the schools. Students could use a terminal(s) without assistance in 15 percent of the schools.
4. Four hundred and seventy schools in the sample had computer terminals compared with 1,209 schools with audiovisual equipment (film viewers, cassette players); 871 schools had microfiche equipment (viewers, reader printers); and 344 schools had sets of needlesorts. In schools having noncomputerized systems, students could request access in over 85 percent of the schools. Students were assigned access by teachers in about 70 percent of the schools, counselors assigned students access in about 70 percent of the schools, and students were assigned access by unspecified persons in 21 percent of the schools. Therefore, in some schools, students gained access to career information resources in more than one way.
5. Schools had more pieces of equipment in the audiovisual and microfiche equipment categories than in the computer category. Students use audiovisual microfiche and noncomputerized sorting equipment only 25 percent of the time it is available for use.

Suggested Causes and Implications:

Schools have traditionally used noncomputerized resources in providing career information. This may be due to the availability of print and media resources or the computer illiteracy of counselors and other staff. Fiscal constraints have undoubtedly been an important consideration in many districts with limited computer access. To purchasers of career products, computer technology is less understood and hence more threatening than other career education technologies. Computer hardware is often seen as belonging to various education support disciplines (e.g., libraries) and requiring professional expertise to assist students in its use — although it has been shown that many career education materials can be handled by students.

As computer terminal use by students increases, costs decrease. Presently, most terminals are used for purposes other than career information. Terminal location can dramatically inhibit or promote student computer use.

Clearly, the days of handing a student a college catalog, the *OOH*, or *DOT* as a strategy for career/occupational guidance are coming to an end. Many of the newer systems have interest surveys as an integral component, and the microfiche systems developed in many states contain thousands of pages of information cross-referenced for easy use. Audiovisual materials bring to life the most remote aspects of many jobs; and this information and these materials are available to every high school in the nation. However, knowledgeable staff are required to ensure proper usage of information, and the dedication of administrators and school boards to the proper dissemination of career development information must become a priority.

Recommendations:

1. As schools decide on materials and systems of career information, they must weigh the cost benefits and predictors of success for the models they choose to use.
2. Counselors and career specialists must be aware of current and projected employer needs and effectively integrate these needs into program goals to meet student needs. Staff roles must be determined so that

clients receive the direction and support needed to process career information.

3. Staff development must acquaint school personnel with the uses and availability of computerized and noncomputerized career information systems.
4. Computer literacy in career information (and other computer learning opportunities) should become a high priority in all schools.

STUDENT USE OF CAREER INFORMATION RESOURCES

Dr. Marla Peterson
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Research Question A: How often are resources used by students? Does frequency of use vary by type of resource?

Major Findings:

The major findings are summarized below:

Table 1. Student Use of Patterns of Occupational Information (Approximations reported in percents)*

Information Category	*% Reporting Use*	*Used Many Times*	*Used Few Times*	*Used Once*	*Never Used*
Reference books	75	10	40	20	20
Magazines	70	10	40	20	25-30
Pamphlets, briefs, kits	65	10	35	20	35
Former student reports	25	5	15	10	75
Card sorts[1]	60	5	30	25	40
Microfiche[1]	48	5	20-25	20	50
Computers[1]	50	5	20	25	50
Talk with counselor (high school courses)	80	20	40	15	15
Talk with counselor (occupations in general)	55	5	25-30	15	47
Talk with counselor (preparing for an occupation)	60	14	30	15	40
Talk with counselor (where to get a job)	40	5-9	20	15	60
Talk with counselor (attendance or discipline)	25	5	10	10	73-82
Talk with counselor (personal problems)	20	5	10	10	76-81

[1] Percentages are based on usage by students who have access to card sorts, microfiche, and computer terminals (i.e., 50 percent of students in 21 percent of the schools with computer terminals used the terminal for retrieving occupational information).

Other findings relative to career information experiential activities included:

- 65 percent of the students had viewed a film or video tape;*
- 46 percent had taken special courses;*
- 45 percent had met with employed workers;*
- 39 percent had participated in a career day;*
- 38 percent had toured a business;*
- 28 percent had met with former students;*
- 25 percent had had a shadowing experience;*
- 24 percent had engaged in simulations;* and
- 14 percent had participated in a work study program.*

Suggested Causes and Implications:

About 50 percent of the students have either never used reference books, magazines, pamphlets, briefs, and kits or have used them only once. Roughly 40 percent of the students who have used these printed materials return to them.

Seventy-five percent of the students report they have used reference books, thus it becomes evident that a large number know about them, yet there is little repeat use. We need to question why they use them so infrequently. Was it a class assignment that first introduced the reference books or a one-shot career guidance effort with no programmatic follow-through? Could the students read the material? Was it meaningful material? Was it current? Was the style and tone appealing to high school students? Was it merely the *Occupational Outlook Handbook* in a new cover with little attempt to liven the narrative? Were there sufficient copies available and were they available in locations frequented by students?

Former student reports seem to be underused. Very busy counselors may lack the time necessary to organize and manage this resource.

Microfiche, card sorts, and computers share one commonality: they are not readily available in many schools. Microfiche is a compact way to store information, but it is passive in nature. It often has no branching or interactive capability, becoming just another form of the printed page. Lack of availability of microfiche readers could be another factor in limited access to students.

The availability of card sorts and terminals in schools using these tools may also contribute to their "repeat use." The more sophisticated the technology, the less repeat use.

Although there is little computer literacy among educators, as computers become more prevalent, increased usage of computerized career information systems may occur. As students become more familiar with computers, they will not be content with computerized career information systems that have little interactive capabilities.

The data related to frequency of student-counselor talks parallel other data compiled in other studies. Because counselors spend a great deal of time helping students prepare course schedules, they do not actually talk informally and casually with them because of time constraints. Course scheduling and "career talks" would seem to go hand in hand, but little is revealed about career counseling.

Since schools tend to establish programs that occur within the school setting, the percentage of students reporting community-based activities is low compared to school-based activities.

The data obtained on frequency of use of various resources by different categories of students is not useful to guidance professionals. There appears to be a relationship between type of student (i.e., noncollege bound/college bound; high/low reader; white/nonwhite) and type of resource used.

The data on most frequently used sources of occupational information (students mostly cited parents or relatives, publications, someone in the desired line of work, teachers, and counselors from a list of thirty-seven sources) are not meaningful. However, data collection design and procedures may contribute to this.

Recommendations:

1. One-time use needs to be studied. Although sufficient for certain students, repeated use could also be an indication of career floundering. Or it could signal a higher degree of planning. One-time use may be influenced by the manner in which career information is presented.
2. Computer literacy training for counselors and teachers needs to become a federal, state, and local priority.
3. In the past ten years, career information has been "infused" into many textbooks, and this type of career information was not examined. A thorough analysis needs to be undertaken.
4. The quality of counselor/student "career talks" needs to be examined.
5. Community resources are underused and ways should be sought to involve community members in career guidance activities.
6. Differentiation of career information responsibilities among school and community personnel should be integrated into a comprehensive plan for each school.

Research Question B: Why do students use these resources, and what motivates them?

Major Findings:

Findings are summarized below:

Table 2. Reasons for Seeking Occupational Information (In percents)*

Reasons	*Percent*	*Many Times*	*Few Times*	*Once*
Talk with parent or relative	79	31	31	10
Talk with a friend	74	20	40	14
Class assignment	65	11	34	20
Talk with a counselor	61	10	32	19
School talk or lecture	58	6	31	21
School film	55	8	28	19
Experience on a job	49	11	24	14
TV or movie	46	8	27	11
Bulletin board	41	6	20	15

Table 3. How Students Learned about Career Information Resources (In percents)*

Source[1]	*Learned About Publications*	*Learned About Computers*	*Learned About Microfiche*	*Learned About Card Sorts*	*Learned About Activities*
Guidance counselor/staff	48	51	35	41	39
Teacher in class	38	34	29	31	47
School librarian	28	10	33	23	8
Friend	21	34	18	16	22

[1] Sources listed from most frequently cited to least frequently cited.

Table 4. Methods for Getting Students to Use Occupational Information (In percents)*

Method	*Somewhat Effective*	*Very Effective*
Counselor referrals	46	47
Group visits	46	45
Teacher referrals	60	30
Class announcements	60	15

Suggested Causes and Implications:

Individuals rather than specific resources, motivate students to seek career information. Interaction with others seems to be a key factor and should not be ignored as more technologically advanced resources are available.

Students are telling others about computers (see "friend" in Table 2). This may be a significant factor that should be recognized.

Recommendations:

1. Methods should be devised to encourage students to seek and use career information.
2. Guidance programs must be developed to include input from parents (i.e., talks with parents are listed as the first reason why students seek career information).

Research Question C: What kinds of information do students seek and obtain from these sources?

Major Findings:

- 64-76 percent wanted information on *prerequisites for a job;**
- 48-58 percent wanted information on *wages and salaries;**
- 45-53 percent wanted *descriptions of job activities;**
- 36-47 percent wanted *lists of occupations they might like;**
- 36-45 percent wanted *job opening outlook* information;* and
- 28-34 percent wanted *job satisfaction* information.*

Suggested Causes and Implications:

Information about the job rather than abilities, interests, and/or other personal requirements heads the list of information sought. Job outlook data are fifth. This could indicate that school guidance programs may need to look at occupational information that focuses on student attitudes, abilities, and interests.

Recommendations:

1. Guidance programs need to teach information seeking skills that focus on "self" and jobs; and
2. Students need to learn how to use market projections of labor.

STUDENT USE OF NONSCHOOL RESOURCES

Mr. Dale Ake
State Supervisor for Guidance
Florida State Department of Education

Research Questions: What resources do students use in career planning in addition to resources of the schools and how frequently do students use them?

Major Findings:

1. One-third of the schools report that career resources are available to students outside the school (e.g., public library, chamber of commerce).
2. Most outside career resource centers are maintained by some state agency.
3. Three primary sources of career information resources in outside centers are: written publications, audio-visual equipment, and speakers or career days.
4. Approximately 50 percent of the students use contacts with persons outside the schools (e.g., parents or relatives, job experiences, friends) when seeking occupational information.
5. When students were asked with whom they had discussed occupations "once," "a few times," and "many times," students reported talking to the following sources (in rank order): (1) parents or relatives; (2) friends; (3) employees in an occupation of interest; (4) counselors; and (5) teachers.
6. When students were asked with whom they had discussed occupations "many times," over 50 percent reported that they talked with parents or relatives; about 45 percent of the students talked with friends; about 15 percent had talked with employees in an occupation of interest and about 10 percent had talked with counselors.
7. When students were asked with whom they had discussed occupations "a few times," approximately 40 percent of the students indicated they had such contact with four sources: teachers, friends, counselors, and employees in an occupation of interest. About 30 percent indicated parents or relatives and about 25 percent indicated they had such contact with employers.
8. When students were asked with whom they had "never" had contact regarding occupations, over 80 percent checked state employment counselors; about 75 percent checked armed forces recruiters and college admissions officers; 60 percent checked former students; about 50 percent checked employers; and between 25 percent to 30 percent checked three areas: teachers, counselors, and employees in an occupation of interest.
9. When students were asked how often they had used various outside resources (on a scale from "never" to "many times"), over 50 percent used the public library, 45 percent utilized employers, and 25 percent to 30 percent used local colleges.
10. When students were asked which outside resources they had "never" used, 85 percent indicated they had never used private employment agencies; 80 percent indicated they had never used state employment offices, regional career centers, or armed forces recruiters. About 70 percent had never used local colleges, 50 percent had not used employers, and 40 percent had never used public libraries.
11. When students were asked about the adequacy of school resources on occupational information, 36 percent said the resources were insufficient, 32 percent said they were sufficient, and 28 percent were not sure. One percent "did not know," and 3 percent did not respond.

Suggested Causes and Implications:

When the research questions were posed to the various target populations, efforts to determine the rationale for the existing situations or the causes behind the responses were not made. Since it has been determined that schools tend to be inadequately financed in providing well-rounded career guidance and career education programs, the students will make use of the most inexpensive accessible resources, such as libraries, friends, family, and employers. Students seem to see teachers and counselors in a limited role. Teachers and/or counselors may not have time to spend with students outside nonsubject related topics and may discourage such interactions. There may be a correlation between the resources utilized by students and the adequacy of the school's career guidance resources as well as the school's emphasis on career education and career guidance. If a school emphasizes career education, students are motivated to seek outside information in addition to school sources, or conversely, if a school places little or no emphasis on career education, students are forced to find other sources of information.

Many students may be unaware of the career information resources available in their community because they are poorly publicized.

Thus, these results point to a greater need for career guidance professionals to examine the effectiveness of current career guidance programs and practices. Since one-third of the schools surveyed reported that career resources outside the school were available to students implies that schools and guidance personnel need to become more aware of what career resources exist outside the school. State agencies responsible for disseminating career information need to place a higher priority on maintenance of career resource centers when developing their annual budgets. Monetary restraints might dictate a stronger emphasis on the use of written publications, audiovisual equipment, speakers, and career days. Since sophisticated computer systems, career guidance programs and counseling are expensive, they may not be used even though the potential for their being more cost efficient and effective is apparent.

Students may use parents and friends more than counselors and teachers because parents and friends have always exerted the strongest influence on their lives. Students may not view teachers and counselors as members of the world of work and may not perceive them as knowledgeable about careers.

Students' contact with state employment counselors, armed forces recruiters, private employment counselors, local colleges, and former students raises a question about their perceptions of the services provided by these sources. Perhaps students are not adequately informed about these agencies or are perceived as a low priority because of their level of maturity. Expenses related to access, travel, and fees for their services could be major barriers to student use of state employment and private employment agencies.

Recommendations:

1. Policy makers and change agent personnel concerned with and responsible for assisting students in career development planning should concentrate their efforts on state agencies' policies that affect the delivery of career guidance and career information programs and services. Efforts should be made so that these policies reflect cooperative working arrangements, avoid duplication of services, and measure the effectiveness of program goals.

2. Trainers should become the most knowledgeable group of professionals so that they can provide staff development training for career guidance personnel on the operation of career resource centers and the utilization of career information services outside the school.
3. Administrators can require career guidance and information program personnel to develop comprehensive programs that contain the essential components of a good management plan. Budgets can be built upon this management plan and with proper evaluation effective staff and program goals can be determined. Administrators may need to become more informed and sensitive to the social impact of students' career development needs and the lack of efforts to meet such needs.
4. Counselors and career guidance practitioners need to be updated through inservice workshops on current programs and practices. Practitioners need to be furnished with adequate budgets so they can build a comprehensive management plan for their career guidance programs. Practitioners need to be involved with all community resources and agencies concerned that provide career development needs of students. They should be provided with a complete list of resources and services available to the school. Practitioners should explore sources of information and delivery modes other than print media and speakers; they should institute programs of career exploration that are an essential prerequisite to proper use of career information resources.

The project reported herein was performed pursuant to a contract (NIE-P-81-0190) from the National Institute of Education, U.S. Department of Education. However, the opinions expressed herein do not necessarily reflect the position or policy of the U.S. Department of Education and no official endorsement of the U.S. Department of Education should be inferred.

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AVA GUIDANCE DIVISION FIELD REVIEWERS

Career guidance professionals who represent a variety of settings participated in this project by reviewing and interpreting the major findings that were prepared as results statements by the AVA Guidance Division — NIE Project Task Force. Their interpretations formed the basis for many of the recommendations in this newsletter. The following individuals served as field reviewers:

Walt Adams, David Belsheim, Robert Bhaerman, Stephanie Blecharczyk, Hartley Campbell, Robert Campbell, Chris Christopher, Richard Feller, Jim Goalder, Oscar Gjernes, Dick Guerra, Lenore Harmon, Don Harrison, Josephine Hayslip, Patricia Hooper, Pete Jones, Fair King, Dick Knowdell, Jerry Laureyns, Evelyn Lavaty, Anita Mitchell, Richard Morrison, Del Nelson, Nancy Nieboer, Iris Officer, Deborah Perlmutter, Pete Peters, Marla Peterson, Linda Pfister, Carl Poole, Sheryl Ranson, Earla Smith, Martin Smith, Robert Swan, Jessie Teddlie, Buzz Vosgerchian, Ed Whitfield, Katie Wilson, and William Wooley.

ETS PUBLICATIONS

The following documents, written by Warren Chapman and Martin Katz, are available for purchase from ETS, Rosedale Road, Princeton, NJ 08541.

Survey of Career Information Systems in Secondary Schools (Study 1), $15.00

Comparative Effects of Major Types of Resources (Study 2), $12.50

Summary of Study 1 and Study 2 (Executive Summary), $2.00 (if purchased alone) or $1.00 (if purchased with either of the above documents)

Other publications growing out of the study may also be purchased from ETS:

Computer-Assisted Guidance: Concepts and Practices by Martin R. Katz and Laurence Shatkin, $5.00

Computer-Assisted Guidance: Description of Systems by Laurence Shatkin, $5.00

A Conceptual Framework for a Survey of Career Information Resources and a Study of Alternative Types by Warren Chapman, $5.00

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MICROCOMPUTER-BASED CAREER GUIDANCE

by Wynonia Dunn, Assistant Director
of DISCOVER Services

What exactly is a microcomputer-based career guidance system in an educational setting? To understand the concept, let's analyze the three components of the term, "microcomputer-based career guidance system". The first term, "microcomputer-based" indicates that a microcomputer is used extensively to deliver career guidance services to students. The second term, "career guidance" encompasses many broad areas - including assessment, information dissemination, information storage, skill development, job placement, student record maintenance. The third term, "system" implies an orderly set of processes and procedures that are adopted to achieve specified objectives within a specific institutional setting.

The heart of a microcomputer-based career guidance system within a school is the career guidance software program. The guidance software enables a student to make sound career-related decisions by providing him/her with the opportunity to do the following:

1) Develop a clear understanding of the self with respect to interests, abilities, and work values
2) Relate self-information to occupational alternatives
3) Relate subject area interest to occupational alternatives
4) Relate job characteristics that are personally sigificant to occupational alternatives
5) Obtain a conceptual understanding of the world of work in relationship to his/her own position within the world
6) Obtain timely, accurate, relevant occupational and educational information
7) Develop an action plan related to career developemnt

A comprehensive guidance software program consists of features and content that provides students with these opportunities. A student may choose not to take advantage of a program capability (such as identifying occupations according to preferred subject area), but the choice rests with the student.

What are the content features of a comprehensive career guidance software program? One content feature pertains to assessment. For example, DISCOVER contains an interest inventory, a work-values inventory, and a self-reporting abilities measurement. A student takes the instruments at the terminal and immediately receives an interpretation as well as feedback as to how the results relate to occupational alternatives. DISCOVER also organizes the self-information for the student in a single-frame format and provides an accumulative list of occupations that have been identified by the computer search using the three variables-interests, abilities, and work values. DISCOVER also provides the student with the opportunity to use score/results received from "off-line administered" batteries as search variables to obtain an appropriate list of occupation alternatives. A second content feature relates to searching for appropriate occupations based upon subject areas found in high schools, community colleges, and four-year colleges and universities. This feature allows the student to directly relate preferred subject area to career possibilities. A third content feature allows the student to search for occupations based upon personally signficant job characteristics such as income level, employment outlook, setting, degree of social interaction and stress on the job. A fourth and major content feature of a computer-based career guidance program pertains to information, both educational and occupational. A student can access information in two ways - direct retrieval or indirect search. With the latter approach, a student searches for specific occupational and institutional names, and subsequently detailed information on each, by using multible search variables. With respect to this feature, computer-based career guidance programs are similar to career information programs. A career guidance program can be used solely for information retrieval, if a student/client desires to use the program in this manner.

A microcomputer career guidance program possesses specific characteristics. Some of these characteristics are similar to those possessed by career information programs while others are unique. Some of the characteristics shared by both are:

- The microcomputer programs are highly mobile. For example, you can take the program and the microcomputer to a classroom, out into the community, etc.
- Both contain annually updated occupational and educational information that can be obtained through both direct and indirect access modes
- Both possess a print capability allowing a student to receive hard copy of the information

Some of the characteristics unique to a career guidance program are:

- A career guidance program utilizes assessment measurements, both "on-line administration" and "off-line administered batteries"
- A career guidance program possesses a highly interactive format

- A computer-based career guidance program stores a "user record" so that a student can return anytime to the program to resume a career exploration activity or to change responses. The user record allows a student to engage in career exploration activities in a systematic way.
- A career guidance program shows the direct relationship among self-information, occupational alternatives, the organization of the world of work, and educational training alternatives
- A career guidance program possesses two components - a career guidance and an information retrieval component. These components can be used separately or in conjunction with each

In summary, computer-based career guidance systems are being established in many schools because of the availability of comprehensive career guidance software programs that capture the heart of the career guidance process. Such programs allow counselors to systematically and efficiently deliver career guidance services in spite of the large counselor/ student ratios. The programs also appear to give students a source of greater control over the career planning process because they can return to the computer whenever necessary to obtain vital occupational and educational information or to alter tentative career-related decisions. Also because of a program monitoring component, the school always has evaluative data with respect to the program's effectiveness.

A microcomputer-based career guidance system that uses a career guidance software package as its foundation meets the needs of students, counselors and the school.

COMPUTERIZED CAREER PLANNING INVENTORIES

By Marilyn E. Maze

What Is A Computerized Career Planning Inventory?

Career counselors use a variety of paper and pencil tests and inventories. Instruments like the Strong-Campbell Interest Inventory, the Kuder Interest Inventory, the Differential Aptitude Test, and many other interest, ability, and personality inventories are used to compile information about the client and to suggest appropriate occupations for the client. Although computers have been used for many years to score these instruments, interactive computer systems have recently opened a vast array of options for career counselors. The standardized tests which have been used for many years are now, or soon will be, available in this format along with many new instruments that were developed just for this new medium. Whether you are designing one of your own, exploring some of the new arrivals, or considering the use of a well-known, standardized instrument in this new format, it is important to be aware of the issues and opportunities inherent in computerizing career planning inventories.

Since electronic scoring has been used for psychological inventories, this batch processing of a paper and pencil test became economical when a machine was developed which could read clients' answers much faster than people could score the instrument. Because each computer scoring system was very expensive, answer sheets were mailed to a computer processing center for scoring and computer printouts were mailed back.

This technology had a minimal impact on clients. Clients filled in bubbles on paper instead of circling their answers and they were asked to use a special pencil for this purpose but they adjusted easily to these changes. The impact of this technology on tests was much greater. Scoring procedures could be much more complex than they had previously been, since computers could handle any level of complexity quickly and easily. This led the creators of tests to develop new and more accurate methods for analyzing results. The Strong-Campbell Interest Inventory, for example, calculates the coefficient of correlation for each of about 200 scales. This task would have been unreasonable without the assistance of a computer.

Batch processing involves collecting the answer sheets, returning them to a centralized location, and waiting for their return. In the late 1960's, computer plus time sharing operating systems were developed. These computer operating systems allowed many users to interact with a computer, simultaneously dividing the cost of computer time among many users. The cost of computers had also decreased, so it was feasible to allow clients to interact with the computer individually during the guidance process.

Interactive computer usage has made two dramatic new options available to designers of career planning inventories. First, the computer can respond differently, based on the client's answers. In the past, every client needed to answer every question but this is no longer necessary. Secondly, the results can be given to the client instantaneously so clients can decide to change their answers. If these instruments measure relatively stable personality traits, changing one's answers should not be encouraged. But if interests or preferences are being inventoried, clients can reasonably change their minds based on the occupations which result from their choices.

Currently, many interactive inventories contain questions about clients' preferences. Thus, clients can use the resulting list of occupations as a validity check on their self-perceptions or values and change their self-description if the first self-description produces results which are incongruent with their goals in life. Other inventories simply computerize the paper and pencil tests. A few inventories use the interactive capability of the computer to respond differently to each client.

The advent of microcomputers--small, relatively portable computers that cost as little as most educational or counseling tools and have a computing power equal to large computers of previous decades--has dramatically increased the activity in this area. Now any inventory or test can be cost-effectively administered and scored interactively. Counselors can either use versions of computerized old favorites or they can seek new instruments which take advantage of the special capabilities of interactive processing.

Most counselors will purchase standardized computerized inventories. But in order to better understand issues in selecting computerized inventories, it might be useful to illustrate some of the issues inherent in computerizing an inventory and then consider the steps you would take if you wanted to computerize your favorite inventory. Because this is a fantasy exercise, we will assume you have obtained permission of the author to computerize the inventory you use most.

First, you would have to decide how much of the process to computerize. It is possible to use a paper and pencil process for answering the questions, let clients enter their answer into the computer, then have the computer score the inventory and present the results in an attractive format. Or, you could use the computer for the entire process, asking the questions "on-line" and storing each answer as it is given by clients. Each of these options has advantages.

Cost is a major consideration. The first option uses less computer time and allows for group administration of the inventory (but still is the least expensive option). If the inventory is administered individually (rather than in groups), the cost of using the fully computerized version would be only slightly greater than the cost of using the partially computerized version.

Another consideration is the emotional and cognitive impact on the client. On-line administration requires the computer to present a long list of questions to the client. While computers may be fun at first, how do clients react when presented with 60 to 400 items flashing at them on a screen? Are these items easier to read because they are presented one at a time, or harder to read because they tend to flicker and, on some computers, are in all capital letters? Does the time go faster when clients answer lists of questions on paper and can see their progress or when they

Why Use A Computerized Inventory?

There are many advantages to a computerized inventory from a client's point of view. First, computers are much more fun to operate than a pencil on paper and while clients are enjoying the process, they are becoming "computer literate." Then, instead of struggling through self-scoring instructions or waiting several days for the results, they wait a few minutes and the computer presents the results. As soon as they see how their answers affected the results, they can change their answers and see if a willingness to work harder in some areas will open up new choices for them. Thus, the process of taking the inventory becomes a learning process, allowing them more control over their lives by changing their behavior or plans before it is too late.

From the test administrator's point of view, there are also several advantages to computerization. First, computerization can cut costs by decreasing the staff time needed to administer and score the instrument. Group administration and batch processing will continue to be the least expensive arrangement for many years, but those tests which have been administered individually can now be administered by computer quite inexpensively. The computer can explain the instructions and present a few sample questions to see if the client understands the procedure. Then it can time the test and control access to various parts, permitting the client to review only the section he/she is currently working on. Then the computer scores the instrument. This saves time as well as permits the use of more complex statistical scoring procedures. Use of self-scoring or scoring keys has, in the past, been a strong limiting factor in the design of tests or inventories and the freedom from these constraints opens up exciting new options for test designers.

What Is Different About a Computerized Inventory?

Earlier in this chapter, some of the issues in computerization of tests were raised briefly. It is time to deal with those issues in more detail. The first question is how does technology affect the client? Commonly, clients react either with excitement or anxiety when approaching a computerized career planning tool. Either of these emotions will affect their ability to follow the instructions and to concentrate on the questions asked. These emotions may also affect their answers (i.e., high technology occupations may be selected more frequently on a computerized instrument than on a paper and pencil instrument). Since computer keyboards are more complex to operate and clients are usually less familiar with them, additional concentration may be needed just to operate them and the client may either respond more slowly or tire more quickly.

The technology also affects the visual impact of the instrument. If the questions are presented on a screen, they may be more tiring to read. If they are presented one at a time, the client's attention will be more focused but the client may have less sense of control and the process may seem more repetitive. If they are written in all capital letters, they may be more difficult to read.

When the client is allowed to change responses, a small number of items (6 to 20) is preferable so that each change the client makes will have a noticeable impact on the results. However, any small set of items which is used to describe a client's personality will, of necessity, contain broad generalities. While there are several theories which describe the world of work using a suitably brief set of variables, such as Holland's six personality types or ACT's 12 families of occupations, this level of generalization also removes some of the client's freedom. As inventories are developed which more fully utilize the interactive capability of the computer and respond in a more personalized way to each client, they become more complex.

This complexity may take two forms: either the designer will decide what should be offered to the client at each point or the client will be given the freedom to control the interaction. If the designer takes responsibility for the interaction, the design problems are greatly escalated since the computer must respond in a satisfying way to every possible situation. In this case, the computer must be programmed to simulate a human counselor and reproducing the flexibility and adaptability of a human being on a computer is not easy.

Alternatively, clients may be offered all of the options and permitted to choose the one they want. This approach greatly simplifies the design issues and puts the responsibility for making a satisfying choice on the shoulders of the clients. But it also requires training clients to understand the options and wisely handle this new freedom.

The results obtained from a computerized interactive inventory are also very different than those from a batch processed or hand-work inventory. In the past, it has been customary to format the results very carefully on a chart or an interpretive leaflet. Using an interactive instrument, the entire interaction or a portion of it may be printed on plain paper. Because the printing process is often relatively slow, economy of words is important and each additional line or feature on the printout must be weighed carefully since it will slow the overall process. Some instruments print the entire interaction, which accessilates economy of words throughout. Others print only those portions selected by the designer as being worth keeping and these segments may be specially formatted for paper. Other instruments allow clients to print any section and trusts clients to wisely choose the portions they will need later. Thus, clients could rush through without printing anything or they could stop at each frame to get a copy, resulting in many unrelated segments placed consecutively on a continuous printout.

As mentioned earlier, cost is also a consideration when an inventory is computerized. Computers can be used to explain the instructions but if these instructions read like pages from a book, computer time can be saved by putting them in a handbook. When videodisc players become sufficiently common and inexpensive, this technology may be employed to provide simultaneous verbal and pictorial instructions for slow or non-readers. If the inventory questions are asked consecutively without being timed or otherwise supervised, it is less expensive and more convenient to leave them on paper so that groups can be tested simultaneously and costly computer time can be saved. Scoring the results by computer can be less expensive than professional scoring and presentation of the results, especially client manipulation (when this is allowed) is cost effective on a computer. But interpretation of the results can use large amounts of computer time and is difficult to program effectively.

The use of computers opens several new options which were not previously feasible. First, computerized systems can be designed which combine a variety of tests and inventories to address several aspects of the client's personality and combine the results into a meaningful package. The resulting personality description or list of occupations produced by the computer could utilize the best integrative test interpretation techniques which are usually available only to a small number of clients who can be seen by a highly skilled professional. Second, this multifaceted testing package could be integrated into a comprehensive career information system which would make occupational and educational information available to clients as they receive the test results. Third, computerized inventories can store information about clients and, therefore, provide a record of the client's growth and interest changes over time. With the emphasis increasingly being placed on accountability, this capability will certainly be implemented in various forms, both in large record-keeping programs on mainframes and on more private floppy disk systems which function much like the career folders currently used in many high schools. Fourth, because of the interactive capability of the computer, inventories will be developed which contain a wide variety of formats that can be selected to suit the client. For example, clients who need a great deal of assistance could be offered a module which provides examples for each item. Or, as clients take the inventory, a noncommittal response could cause additional questions to be asked while strong opinions could trigger a shortcut of the usual process. Ability tests could present a short module which produces a rough estimate of the client's ability. The result of this module could then trigger the presentation of a carefully graded set of items to assess the exact level of ability of the client. The complexity and variety of designs is limited only by the imagination of the designers.

What Criteria Can Be Used To Distinguish Among These Instruments?

As with all inventories, the computerized versions must ask the right questions to produce relevant results. For some counseling situations, the inventory items should relate to the exercise and instruments which precede them. In other situations, little assistance is available and the items should refer to issues on which clients can easily self-assess. Since many clients have little accurate self-awareness, the items may need to be very obvious in order to produce valid results. In other settings, a variety of instruments are used and computerized inventories may be selected which ask different questions, from a different viewpoint, than the items included in inventories currently in use.

Next, it is wise to check the reliability and validity of the inventory. Does the instrument produce consistent results when administered twice to the same clients? Does the inventory select occupations which are appropriate for the client? Because this issue is very difficult to assess, a variety of data are usually available from the test publisher to reassure the counselor. These issues are the same for computerized and conventional instruments.

The use of a computerized instrument is much more complex than the use of conventional instruments, so it is very important to try the instrument with a client or two. The computer program should be friendly, engaging the client in a comfortable, reassuring way and providing sufficient explanation before starting the assessment process. The client should be able to move through the instrument without assistance from a counselor. The responses required of the client should be brief (typing skill should not be an issue) and easy to learn. When these conditions are met, most clients will enjoy using the computerized inventory.

Unfortunately, it is necessary to limit your software considerations to programs which run on the types of computers available to you. Because of the lack of compatibility among both large and small computers, computerized instruments can only be used on the computers for which they are written. This hardware issue significantly limits the instruments available to any site unless a variety of computers are available.

Finally, cost must be considered. The cost of using a computerized instrument will be a combination of the per client cost of the software and cost of using a computer or computer terminal for the amount of time required for each client to complete the inventory. The costs of inventories now available vary greatly and may be an important factor when weighed against the make of each.

It is not easy to distinguish effectively among the available computerized inventories. The issues are so new that few people, even among the "experts" in this field, are able to effectively evaluate the value of each instrument. As a result, new instruments are springing up everyday; test and textbook companies are designing their own inventories with little understanding of the issues raised in this chapter. This state of confusion will probably continue until counselors become sophisticated enough to recognize the difference among the hastily constructed imitations and the truly well-designed computerized inventories.

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JOB SIMULATION -- THE FUTURE IN BUSINESS AND OFFICE EDUCATION

by

Quentin T. Wells

Most computer hardware and applications programs in the business world perform their functions very well. They were designed to do a job and they do it. And that's precisely what's wrong with them as educational tools. The jobs they are intended to do almost never include student instruction. And yet, that's exactly how they're usually used in the classroom. The result is predictable. They don't perform well in this environment. Students don't learn effectively from them and teachers are frustrated trying to teach from them. They're production software, not instructional programs. That's an important distinction to make.

Word-processing programs and stand-alone systems process words and text as directed by the operator. But none of them instruct the operator in the fundamentals of word processing, provide evaluation of skills or performance, or give any actual direction as to how to use the program or equipment itself. They are all production-oriented rather than instructional systems.

Electronic cash registers provide a still more striking example. Highly efficient in recording sales, they provide no instruction whatever to their operators, who must be specifically trained by an outside teacher not only to use the machine, but to perform the peripheral tasks associated with it: counting money, identifying checks, making credit card sales, etc. Again the system is production-oriented rather than instructional.

This type of educational approach to computers amounts to regression to a journeyman-apprentice relationship in the instructional process. It's the wrong direction to proceed.

> As long as only a few people needed to learn a very limited scope of material, apprenticeship methods, informal and later formal, were satisfactory. But as the number of learners and what they needed to learn increased, learning strategies had to be modified. Most of our current educational methodology at all levels is shaped by the pressure of large numbers. Thus the lecture, the textbook and later electronic recording and broadcasting media are all mechanisms to disseminate knowledge to large numbers of people. All are essentially one-way media, with communication flowing from the instructional authority to the student; they provide little if any capability for the authority to respond to individual learners.
>
> Something has been lost in this process. Teachers and students in formal educational institutions yearn for the situation where they can work together closely...
>
> The computer is the first technological innovation in education that enables us to start moving back, even with a large number of learners, to a situation like that of Socrates where the educator can respond fully to each individual learner. *1*

Production-oriented computer applications are used extensively as teaching tools because they're readily available, while instructional programs, those designed to teach an application rather than to perform it, are comparatively rare. Business-oriented instructional programs are only now appearing on the market. One of the most promising types of these programs is job simulation.

Simulation is the controlled imitation or model of an actual situation. It isn't a new technique.

> Already there are simulators to teach people how to operate every kind of moving vehicle -- including trucks, tanks, surface vessels, submarines, railway and subway trains, and, if we include the driver training systems coming into wider use, automobiles." *2*

Flight simulators for pilots have been used successfully for many years. Astonauts routinely simulate every detail of their missions under controlled and replayable conditions on the ground. Medical researchers and sophisticated surgical teams simulate the procedures they intend to use, sometimes for years, before they are ever tried on a living patient.

As these examples indicate, simulation is a highly regarded training technique wherever the risk or potential cost of failure in the real-life situation is high. Crashes in the flight simulator cause no loss of life or property. The computer, however, has expanded the potential scope of simulation dramatically.

> The computer can be used to generate rich, creative, manipulative environments for the learner, environments difficult to manipulate and experiment with in the real world, even environments which are impossible. *3*

As computer technology continues to revolutionize business and office functions, the need for effective computer training in all managerial and clerical occupations has grown apace. Fortunately, the technology that created the need can also supply the solution. Computers can simulate a wide variety of job functions and business management situations cheaply and effectively. The equipment they simulate best is themselves.

Job simulation is a form of instructional program which directs a computer to simulate the functions of one or more pieces of computerized business or office equipment and simultaneously provides hands-on, interactive instruction to the student on how to use that equipment. In this mode the computer can then provide a number of highly effective learning experiences for the student. Among these are:

1. Computer literacy and hands-on experience. The student learns on a computer how a computer functions, the enormous number of tasks it can be programmed to perform, and the basic methods by which it performs them. Hands-on computer operating experience in a business environment is also acquired. In a job market where an estimated 75% of all positions will be computer-interactive by 1985, this experience is critical.

> California computer consultant Arthur Luehrmann calculates that ten to twenty hours of 'hands-on' computer experience translates into a $1,000 annual advantage in the job market. *4*

2. Realistic job task training. A single computer can be programmed to simulate many business functions. The student can be given tasks and training instructions in each application and can then perform the job functions as if using the actual system. Experience and knowledge gained can be transferred to on-the-job situations with minimum difficulty. Career Research Corporation's program "The Cashier", for example, simulates four

3. Extensive student-computer interaction. The computer is used as a line instructor rather than as a printed page. It directs the student in task performance, simulates the equipment that will be used, permits the student to actually input data and extract output from this equipment, and evaluates performance. The Minnesota Educational Computer Consortium (MECC) program "Business Volume 3" provides a sophisticated accounting system model in which students input voucher, invoice and inventory data to produce computerized general ledger, accounts payable, accounts receivable and inventory control records. *6*

4. Instant evaluation and feedback. The student can be checked at each step of the simulation and told how to proceed. Errors can be noted and corrected, steps repeated for greater emphasis, or the program can branch to provide additional drill and instruction where areas of difficulty are encountered. All evaluation can still be performed within the simulation environment. The student can clearly see the result of inaccurate work in the actual job task and can relate to the importance of correct performance on the job. Career Research Corporation's "Reservations Clerk" lets students find and confirm airline passenger reservations on a simulated PARS network. Only by correct operation of the computer terminal, as directed in the simulation, can the right flight be booked and the customer's tickets printed. *5*

5. Repetition as required for learning reinforcement. The

simulation can be repeated as often as required until the student feels comfortable with the work situation and can perform the tasks effectively.

6. Non-judgmental learning environment. This is particularly important for the slower learner. Simulation provides tasks, instructions, and evaluation of performance in a strictly objective fashion. The Opportunities for Learning, Inc., program entitled "Trucker" pits the student against a model environment in which management decisions must be made to get perishable cargoes to their destinations. The companion "Streets of the City" program allows the student to manage construction of roads and transit systems by allocating limited resources. *7* In this type of program, the student can learn without concern about competition or comparison with others. The computer is recognized as a machine and its consistency and objectivity in instruction causes the student to relate to it as an object to be controlled and mastered rather than as an adversary to be overcome.

7. Individualized, self-paced instruction. Each student can complete a simulation program at his or her own rate. Even when a program is network-loaded to a series of microcomputers, each machine can run independently and provide corresponding personalized instruction to every student.

8. Computerized scoring and grading. Because a simulation

program presents the student with preprogrammed, structured exercises to complete, the correct responses can also be programmed and the student's performance scored and graded entirely by the computer. There is no longer any need for either the instructor or other students to grade work performance. Student scores can be acumulated automatically and stored by the computer for later review by the instructor. Individual scores can be analyzed and compared with class or school averages and more broadly based norms. No active class time need be devoted to record keeping tasks since all scores are kept in storage by the computer.

9. Largely Instructor-Independent Learning. Instructional programs such as job simulation free the instructor from the necessity of maintaining a highly structured classroom environment and of teaching every concept to the class as a group. With this type of programming, the computer at last becomes a genuine educational tool which accomplishes basic instruction processes while allowing the teacher to concentrate on individual problem areas and questions.

The features detailed above reveal several inherent advantages of job simulation programs over comparable production equipment and software. The first and most important of these is obviously the instructional ability of simulations, which is simply not available in most production programs. Job simulations teach students how to perform functions rather than merely performing those functions as directed by an already-trained operator.

Job simulation programs offer high versatility with a minimum of equipment. Since they can be used on general purpose computers, a single oiece of equipment can be used to accomplish many job simulations. The Search Series of programs developed by Tom Snyder and available through K-12 MicroMedia includws five simulation programs which can all be run on an Apple computer, *8* while the Career Research Choice series includes simulations of 27 occupations and is available for three different computers. Special purpose computers, word processors and cash registers for example, are by design very limited in application. They are also usually more expensive than general purpose computers; third advantage of job simulation programs.

They are highly cost and space effective when compared to production equipment and software. The cost of a single word processing system may be 5 to 8 times greater than a microcomputer capable of running excellent quality simulations. An equal investment will therefore buy only one production station in comparison to half a dozen general purpose computers, each equipped with a job simulation program that teaches an application instead of merely performing it.

Its versatility also means that less space is required for the use of job simulation equipment than for production-oriented machines.

Since one computer can perform many simulation functions, less total equipment is needed and special purpose units are not left idle when students move to other phases of instruction.

Finally, job simulation programs can be updated at far less expense than special purpose production equipment or software. This fact enables them to be kept current with the latest technological advances at far less cost than purchasing new production equipment. This advantage is becoming daily more important as the pace of computer development accelerates.

The above discussion might lead to the conclusion that job simulation programs consist entirely of benefits without liabilities. Alas, such is not the case. It's good to know the limitations of these programs so that they won't be subjected to the same misuse and abuse that has befallen many production programs.

Job simulation programs are not user programs any more than vice versa. They are usually not adequate for heavy production applications. They permit the student to apply the instruction provided to specific exercises, but these are limited and the programs should not be expected to perform beyond their design capability.

Because they are usually designed to teach the generic functions of an application, job simulations are not adequate to train a student in the operation of a specific piece of equipment. All the principles in the operation of the PARS airline reservation network can be taught using simulation, but the specific operation of a brand name terminal connected to the system, will probably not be covered. Making job simulation specific to equipment reduces the scope of its use. If sales are limited, the price will be higher. Most simulations maintain a generic approach to instruction.

And last, the cost. Good job simulation requires complex programming. The simulation must be able to imitate the equipment used on the job, present the student with data and problems which can be input into the simulated system, evaluate responses and give appropriate feedback as the system is being used, and record the student's scores. Four major program functions are required instead of the one performed by a typical production program. Most programs also require extensive documentation and student work materials. All these items add to costs. There aren't any job simulation programs in the $10.00 price range. Most will range upward from $100.00.

The job they do, however, is worth the price. These programs are designed to teach. Students "love" them. They make a challenge out of learning without creating a threat of failure. Their technique transfers all the ingrained appeal of an arcade game to the real world of work. They make students want to master the computer and all its intricacies. They give instructors the unique problem of having to literally drive their students away from the classroom at the end of each day. They make learning real, fascinating and fun.

NOTES:

1 Bork, Alfred with Stephen D. Franklin, "The Role of Personal Computer Systems in Education," AEDS Journal, Fall, 1979.

2 Hellman, Hal, "The Simulated Society," Omni, August, 1980.

3 Bork, Op.Cit.

4 Williams, Dennis A., etal, "The Classroom Computers," Newsweek, October, 1981.

5 For details of this and other Career Research Corporation job samples, write Career Research Corporation, 65 W. Gordon Ave., Salt Lake City, Utah 84107.

6 For more information on this program, write Scholastic, Inc., 904 Sylvan Ave., Englewood Cliffs, N.J. 07632.

7 For more information on this program, write Opportunities for Learning, Inc., 8959 Lurline Ave., Dept. L12, Chatsworth, CA 91311

8 For more information on these programs, write K-12 MicroMedia, Inc., P.O. Box 17, Dept. G, Vally Cottage, N.Y. 10989.

EMERGING CAREERS: THE CONSEQUENCES OF HIGH TECHNOLOGY

By Judith M. Rodenstein, Ph.D.

According to futurists, there is a new revolution upon us which will affect the way people earn money, spend their leisure time, and relate to one another. These dramatic changes will be the direct outcome of high technology. Some occupational forecasters believe that high technology applications at the work site will be the catalyst for the permanent elimination of up to 45 million jobs once computerized, labor-saving devices become operant. According to Occupational Forecasting, Inc., a consulting firm in Arlington, Virginia, "Robots, automation, communication and computers are changing the entire occupational infrastructure of U.S. industries."

In newspapers, magazines, and television advertisements, we can feel the excitement and challenge to create--which is part of the "high technology revolution." We will all be able to complete tasks, engage in stimulating activities and process information in a way which we were never able before. Yet, at the same time we hear of the tragedies of workers who have spent 20, 30 or 40 years in an industry and have lost their jobs permanently because technology can now do their jobs more effectively. How can this conflict be resolved?

The innovative changes in the structure of work and the work force, on one hand, are eliminating jobs and, on the other hand, result in what are called "emerging occupations." The definition of that term is:

> Emerging Occupation - Those for which new employment opportunities are well evidenced in the changing patterns of business, commerce, industry, science, technology and arts. Such occupations generally do not have a well-defined occupational title, qualification, or employment classification and wage standards. They appear rather amorphous, but sufficient employment is occurring to identify this occupational area. The numbers of workers employed in these emerging occupational areas are likely to be growing at a rate substantially above the average of all occupations; new educational and training programs are being established and demand exceeds supply; shortages are clearly evident. (Occupational Forecasting, 1983)

Employers and employees then need to consider the following questions:

- Which jobs will be discarded in my industry?
- Which new occupations will be created in my industry?
- How will these sweeping changes affect the jobs of both blue collar and white collar workers? (e.g., What new skills need to be mastered?)
- What are the challenges and opportunities for the nation's primary trainers of labor, the educational and training systems?

This chapter will answer some of these questions by examining several emerging or changing occupational clusters which are a direct result of high technology applications: robotics, communications, medicine and manufacturing. The occupational categories chosen for discussion are by no means inclusive but serve to represent the range of careers which will emerge and/or change as they interface with computers.

Robotics

It is common knowledge that robots are finding their way into the workplace. In fact, when the data related to sales and production are examined, the scope and impact of robotization is staggering. Robot sales in this country are growing at an annual rate of 35 percent. Optimistic forecasters are predicting general sales of robotized manufacturing equipment in the United States to reach $2-4 billion by 1990. The following forecasts have also been made:

- By 1985, 20 percent of the labor force in the final assembly of autos will be replaced by automation. (One automobile manufacturer alone has announced plans for 14,000 robots by 1990.)
- By 1987, 15 percent of all assembly systems will use robot technology.
- By 1988, 50 percent of the labor in small component assembly will be replaced by automation.
- By 1990, the development of sensory techniques will enable robots to approximate human capability in assembly.

(National Center for Research in Vocational Education, 1982)

Currently, robots help weld, cast, form, assemble, paint, transfer, inspect, and load and unload parts into and out of a number of different machines. Reprogrammable robots can be used for diverse production operations or single function operations. No longer are robot microprocessors attached only to mainframe computers but they are becoming flexible units, flexible enough to be part of a major restructuring of manufacturing operations which mix human and robot jobs.

Despite all the publicity attending this new development, the issue of what a robot is, generally is not well defined. Although one tends to think of a mechanical person as a "robot," a better term for what is commonly being placed in industries today is a "robot-arm." It is essentially a mechanical arm that is bolted to a base and fitted with a special set of fingers or tools and then programmed to go through a series of repetitive motions to perform a particular task. Most models do not possess the ability to move around a factory from one location to another, nor do they generally have the ability to sense the task performed. The Robot Institute of America defines an industrial robot as,

> "a reprogrammable multifunctional manipulator designed to move material, parts, tools, or specialized devices through variable programmed motions to accomplish a variety of tasks."

The terms "reprogrammable," "multifunctional," "variable programmed," and "variety of tasks" are the key words which differentiate robots from other forms of special-purpose or fixed automation. These key words refer to the ability of the robot to be adapted to many different kinds of jobs in many different industries. In contrast, fixed or special purpose automation is less universal and includes machines designed to do one particular job in one specific industry.

In order to understand what careers will emerge from robotics, it is necessary to understand how the "robot technology" is being applied. Currently, the metal working industries most aggressively utilize applications of the robot industry. Machine tending has been one of the largest areas of robot application.

One of the earliest and most successful applications was unloading diecasting machines. Robots have also been used in the diecasting industry to load inserts into the dies, lubricate dies, feed castings to quench and trim operations and even to ladle metal and deposit scrap into remelt systems. Unloading injection molding machines is a similar application that has also employed robots successfully for many years.

Foundries have implemented a relatively small number of robots, but have used them in a wide variety of applications. Robots are used to transfer hot castings from continuous pour lines to shakeout equipment, and to remove cores from core making machines. Applications in mold construction include installing and removing mold clamps, setting cores, venting molds, and flame drying molds.

A very large area of application is resistance welding applications, principally done in the automobile industry. Typically, a large number of robots are used within each system. In these applications, the robots handle weld guns and tend indexing on continuously moving lines. When welding smaller parts, it is possible to have the weld gun in a fixed position and the robot is used to move the part through a stationary weld head.

Spray painting is the most common application of continuous path robots. Material handling application of robots are common in all segments of industry. Robots are used to stack and destack, load and unload conveyor lines and to palletize.

Naturally, as the number of uses for robots increases, the potential need for people in new jobs related to robots also increases. There are three types of employers where those with training in robotics will be in considerable demand. The first is robot users, second--robot manufacturers, and the third is in the field of education where many institutions are currently expanding their programs to include instruction and job upgrading in robot-related subjects.

According to William Weisel, Prab Robots, Inc. (1983), the following categories of job assignments are forecasted in the field of robotics:

- Research/Development
- Design
- Manufacturing
- Application
- Marketing
- Service/Maintenance
- Training/Teaching

Each job category will now be further defined as it relates to industrial robots.

Research/Development. These activities may take place at robot manufacturers with robot users, educational institutions and/or consulting firms devoted to robotics. Subject matter is primarily in the area of applied engineering or computer sciences.

Design. Design includes the design of the basic robot, the controls and related equipment. Educational background to do this work would include approximately a BS level of mechanical engineering. Control design could be done by a robot manufacturer or by a manufacturer of controls. Educational background needed would, at the least, be a BS in electrical/electronic control engineering. Application or modification of controls could be done by a technician with an associate degree. Design of the related equipment required to integrate a robot into an already existing manufacturing system could be the responsibility of the robot manufacturer, the user, consulting firms, and/or equipment suppliers.

Manufacturing. Two different points of view need to be considered when assessing the future jobs in the field of manufacturing robots. One set of skills are needed during the process of manufacturing the robot and related equipment. Another set of skills is involved in the utilization of the robot within the manufacturing system.

Producing robots requires knowledge and skills similar to those required for production of machine tools, material handling equipment and other types of capital goods. A wide range of educational background can be appropriately adapted for entry into these kinds of jobs. For example, a simple lathe, which produces standardized parts, can be operated by an individual who was merely trained on the job. More complex processes could only be successfully completed by a worker with an associate degree in the particular tool technology,

When the robot is assembled, it will go through a test period where all segments and parts will be tested to see that they withstand stress and operate properly under the appropriate environmental conditions. Individuals involved in quality assurance will need to attain at least an engineering technology associate degree to understand the testing information and instrumentation.

Application. New career opportunities will also be available for individuals who will implement an overall system. The educational equivalent of a BS/MS in industrial or manufacturing engineering is necessary for these new occupations. As the complexity of the system increases, so does the need for greater education. For example, a machine which needs to repeat the same welding operation over and over again on every car on an assembly line would require a different level of knowledge than a robot which needs to be programmed to selectively perform an operation on certain products.

Being able to justify the purchase of a robot involves another set of skills--the ability to analyze the basic cost factors in setting up, selecting, and using a robotic system in a way that results in efficient and quality production. A background in industrial engineering is necessary for the type of analysis done here. In addition, controls and programming are major areas of attention. Again, the complexity differs based on the application and method used to integrate robotics into the manufacturing process.

Marketing. Most manufacturers have their own sales representatives and distributors. Personnel engaged in sales of systems should have the following skill: in-depth understanding of robots. The individual should spend time in all areas of the manufacturing plant: the shop, design department, field service activities. An associate degree in engineering technology is the minimal degree which should be obtained by a person in this position. Also necessary are skills in human relations. Thus, a person with strong technical skills and communication skills will be able to explore a career which would involve approaching prospective manufacturers who could use robots in a wide range of application.

Service/Maintenance. Because it is necessary for the robot to function property once it is in operation, new jobs need to be created for the servicing of industrial robots, ensuring that the operational problems connected with the robot are solved, along with minor adjustment and modifications which are needed to flexibly fit the robot into any assembly line. In addition to the service work, there is also a need for workers who are capable of installing entire robotic systems in a factory.

Training/Teaching. Robot manufacturers provide training for user personnel and their employees. They are responsible for two types of training about their robots. The instructions can be aimed at an overall understanding of the operations or on only one of the functions. An educational background is especially important at this stage, along with a technical background because materials must be presented in a way that will be understood by a layperson. Teaching robotics also takes place in educational institutions. Courses may range from an introductory course in a technical high school to a doctoral level course at a university.

In summary, the number of robot installations is steadily increasing. This growth offers new job opportunities. As a result of robotics, a variety of jobs will also be created in education, business and industry. A general technical education is a necessary first step in these careers. However, individuals who want to succeed in robotics will also need to complete specialized training either on the job, at robot manufacturers, educational institutions, or those companies which provide goods and services associated with robots.

Communications

We've all heard of cable television and telemarketing--but what are laser technicians? teletext operators? electronic switching systems? They all represent what has and is happening in the communications industry as a result of high technology applications. "Telecommunications" is the word used to describe the impact of microprocessors on the field of communications. Because of the variety of applications, the best way to define telecommunications is to give examples of it. Telecommunications are data networks, satellite and digitally-encoded telephone and telecopy devices and systems, optical fibers and cables, electronic mail and shopping services, text editing and distribution systems, and electronic funds-transfer systems.

It has been forecast, that in the future 14 million billion intercommunication connections will exist--a universal interconnect system between industry, home and the office which will serve a vast array of information processing devices, equipments and systems transmitting any information in any format (including stored voice, patterns, video images) to anywhere in the world. To achieve this, optical fiber cabling will replace copper cabling and, thus provide superior transmission, loading capabilities, and fidelity. All types of communications will be affected by telecommunications, e.g., information, entertainment, and data manipulation are becoming available to government, business, and private systems. Electronic office and automation will affect more than 75% of the approximately 50 million white collar jobs. An information system such as Videotex will revolutionize financial transactions, retailing, advertising, and related information services. In fact, it is forecast that by 1990, 20% of all U.S. retailing will be over videotex systems. Forty-five million homes will then be equipped with equipment which will need to be serviced. Paperless offices will lead to paperless homes through the development of such systems as Teletext--the electronic newspaper in operation in England and experimentally in the United States. Uses of telecommunications are expanding at such a rapid rate that futurists are calling the information world of the 1990's, "The Global Village."

What does all this mean to the world of work? Who are the companies (future employers) that are emerging as leaders in the telecommunications industry? They currently include:

- telephone companies and services
- cable television networks, stations and businesses
- national and local weather forecasting services
- United State defense systems
- Automatic Teller Machine networks used by banks
- computer-assessed networks
- stock market brokers, bankers and other financial managers
- radio, television and news networks and "superstations"

(National Center, p.6)

To be more specific, AT & T has installed the first part of a laser-powered fiber optics system on the East Coast. Voice and data transmissions are sent over glass strands. Light pulses, rather than electrical signals, will be the workhorses of the information age according to R.W. Kleenert, President of AT & T's long lines department. It is part of the company's expanding system of advanced communications systems, including digital microwave, satellite, cable routes as well as laser systems. Digital communication across continents is all a part of AT & T's future.

These service-oriented systems will rely, in turn, on the services of manufacturers of telecommunications equipment. The equipment will no longer consist of parts that need to be assembled but instead will be dependent on computer-operated design and production. In fact, the number of workers needed to assemble the equipment has already dropped dramatically. For example, Telecommunications Ericson in Sweden reduced its work force from 15,000 to 10,000 workers between 1975 and 1978 (Norman 1981a). This trend has been happening all over the world.

Installation and maintenance labor will be similarly affected. An example that is obvious to everyone that owns a telephone is the advent of the do-it-yourself phone installation. A technician used to schedule an appointment to come to a house and install the telephone system. That is no longer the case. Jacks are placed in houses and residents can buy their own telephones and install them with a small clip. The labor demand for line and cable workers is also declining for similar reasons. Permanently installed lines, buried cables and quick-connect terminals are regularly used in all communication systems.

New switching equipment will also affect the jobs of telephone operators. Mechanical voices and verbal discrimination capacities which are built into computers will soon depress the need for telephone operators even more.

Several new occupations are appearing as the more traditional occupations are being phased out. Laser technician is a new and growing occupation. Lasers are currently being used to communicate images, words and pictures that are transmitted across the country for newspaper copy. According to Orth and Russell (1980), it is reasonable to assume that the use of lasers will expand in the future. They are capable of communicating a vast amount of information and the fiber optics used are resistant to electromagnetic deterioration. To become proficient in this field, technicians would need to enroll in a Laser/Optics Program and study how the laser optics system works, why they work, and how to direct and control the laser beam.

In the telephone industry, most technican jobs are with switching systems or with signal transmission. The new electronic switching system (EES) is programmed to fit each office. Thus, installation and maintenance is different than with the older systems. EES is programmed to monitor its own performance and diagnose circuitry problems. There are no moving parts which need to be repaired but knowledge of electronic computer-based systems is required (Dymmel, 1979).

Likewise, in the transmissions systems, such as cable networking, job skills are changing. Again, the optical systems involved will be reengineered and all equipment will remain principally electronic in its operation. So, although there will still be a need for workers to bury cables and install quick-connect terminals, the entire job picture might change dramatically again in the near future with the new space shuttle system which will put many communications satellites into orbit, thus increasing direct beam transmission by satellite and reducing the number of cable television technicians needed.

New jobs are not expected in great numbers with the applications of high technology to communications systems, aside from the laser technician and the need for more programmers and computer specialists. Instead, the production and monitoring skills needed by workers will change with the presence of computerized monitoring systems and electronic operations.

To summarize these changes, a job announcement in the area of telecommunications might now read as follows:

> Because of our commitment to innovation, the Switching Systems Division of ______ is involved in the design and development of a distributed microprocessor controlled digital tandem telecommunication switching system. This specialized common switch (SCX) has a 3000 port capacity. You will be responsible for maintaining customer system in operational status, performing routine preventative maintenance, and installing and testing new software releases at our customer site in Everycity U.S.A.

Medicine

Medicine and electronic engineering have joined together and applied high technology to the art of healing. Technical innovations have led to more sophisticated specializations throughout the entire medical services hierarchy. The increased number of specialists has resulted in a larger bureaucratic organization and the consequent emergence of new occupations. This is apparent in clinical services but has an especially strong impact on the career structure in ancillary departments.

What has happened in the health fields? Microchips, portable batteries, electronic rivision, senses developed in robots, microsurgery, and genetic engineering are exciting applications of high technology which have taken place just during the last few years. Research in robot intelligence to benefit the disabled and handicapped continues. Programmers, technicians and educators are working with computer-based machines which will aid the disabled and elderly in keeping their lives independent.

Two trends will occur in the health care industry which parallel what has been seen in many other occupational areas when high technology applications become prolific in an industry. A number of new occupations will be created, but more importantly, old jobs will need to incorporate new skills so that the new "high tech" job tools can be mastered. Professionals will be needed to design, purchase, and maintain the machinery. This necessitates the need for bioengineers, electronics technicians, materials management staff, and data entry personnel. For example, a worker in the National Tumor Registrars Association will now be able to establish and maintain a register to follow patients with a diagnosis of a tumor, maintain treatment records, retrieve and analyze that data and disseminate it to other professionals (Orth and Russell, 1980)--an ineffective and tedious task before computers were introduced.

In addition to the skill upgrading of already existing occupations, there are several new fields in medicine. One such field is that of medical electronics technican. The technicians need to master not only the skills required by artisans or radio/television repairers, but also must have an understanding in human physiology. Training would involve a program which blended knowledge and skills in mini- and microcomputers, electronic devices, electronics, medical instrumentation, human physiology, medical instrument safety and grounding techniques, semi-conductor circuitry, and principles and design of medical electronic equipment. Students need to be able to repair, calibrate and use the medical devices. Most of the jobs currently are in hospitals. Job titles connected with this type of occupation are medical electronics technician, biomedical engineering technician, and biomedical research assistant. They are also employed by medical instruments manufacturers to help install and maintain equipment once it is sold to a hospital. Those individuals with a background in education might also train staff how to use the equipment. The bionic man and woman were once thought of as characters only on an adventure show. With the proliferation of microsurgery and mechanical/engineering dimensions into medicine, the fantasy has become reality for many people.

Advanced Computer Applications - Careers Related to CAD/CAM

Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) is becoming critical to design and production in successful manufacturing facilities. CAD refers to the designing, drafting and analyzing of machine parts through computer graphics displays on a screen. It not only speeds up the laborious work of drafting but also enables the designer to study various aspects of an object by rotating it on the computer screen, separating it into segments, or enlarging/shrinking the details. CAD programs also allow the designer to: do on-screen stress tests and then modify the design based on the results of that test, and determine numerable calculations on the design before it even leaves the designer's screen. This means that something like the Fisher body of a car can be designed on a screen. While on the screen, it would be possible to determine how strong the body will be, what it will weigh, how it will perform and the parts that need to be modified for a successful performance. (In fact, the parts can actually be fixed right there on the screen before the car is even built.)

CAM, on the other hand, is not quite as innovative, that is, until it is combined with CAD in an industrial setting. CAM alone is merely the computer control of production machines. This ranges from machine tools running on punched tape instructions to programmed robots. CAM results in increased speed and accuracy in a manufacturing facility. CAD/CAM together can shorten the time between design and production. The product can be designed on the screen and, once modified and refined (CAD), dissected into production stages and production schedules by CAM programs.

This trend in using CAD/CAM in industry is growing. According to the January 1982 issue of Electronic Design's technology forecast, 7,500 CAD work stations had been installed by 1980. The number is forecast to grow to 75,000 by the end of 1985. CAD/CAM thus represents a career cluster of new occupations and new training potentials in business and industry.

The workers trained to fit into these occupations can be new workers trained specifically to work at a CAD/CAM station or can be upgraded employed technicians who need advanced CAD/CAM skills that can be learned at a technical college or a college engineering program. Most of the CAD/CAM careers will involve use of the computer in one or many aspects of design and production.

The first apparent changes in already existing careers will be in the drafting and design functions--replacement of drawing boards with computer graphics design stations. The designer would be required to use and operate the new tools present in the computerized design station, in addition to the new vocabulary of "computerized drawing." Very little knowledge about computer science would be needed. Instead, the designer would be trained in an engineering discipline such as mechanical, electrical, civil, or in commercial art. In addition, new career skills related to helping engineers become more effective managers of the advanced technology workers and equipment would need to be developed. The automation of industry will thus begin when all design information is placed in computer memory. This would then represent a current, available data base which would be accessible to all departments. Information could then be used for designing parts, developing an assembly schedule as well as for material planning, accounting and other business management applications.

Further down the line from the design functions will come the application to the actual manufacturing processes. The technologies, as applied to the production processes, will affect employment levels, occupations and skill content. For example, in the textile industry, new technology is expected to replace 300,000 textile workers by 1990. Patterns can be cut by computer-controlled machines. Sewing machines are also able to be computer-controlled. The same trend is likely to be seen in most industries which can effectively change over to computer-controlled production machines.

The careers in industrial maintenance represent one of the few occupational areas which are expected to grow as a result of the technology. The growing complexity of the CAD/CAM equipment will result in a greater need for workers with skills in the area of industrial technology.

There is little evidence that entirely new jobs will need to be created to keep up with the advent of CAD/CAM, but instead, workers will need to be upgraded by learning how to work with new "job tools," incorporating both new knowledge and skills into their current job content. The typical job description will look like the following:

> DRAFTSMEN: We are currently looking for mechanical draftsman for a CAD/CAM system. Experience in CALMA Graphics or Gerber Systems required.

Some occupations in design and manufacturing will probably not survive the new technology. Those that do will require, at least, an elementary knowledge of computerized control systems.

Conclusions

In summary, from this brief overview of several occupational clusters, it is clear that the challenge of change confronts the world of work. While an array of occupational titles have developed from high technology applications (such as Industrial Laser Process Technician, Industrial Robot Production Technician, CAD Terminal Product Engineer, and Bionic Electronic Technician), nevertheless the skills needed for many of these careers are those which can be learned by today's workers through an upgrading-training program. For example, even though using CAD is a new technique for draftsmen, it is not necessary to eliminate all draftsmen from the work force and take a new crop of graduates and teach them CAD. Instead, most of these emerging careers can be available to workers who enroll in a retraining program which will teach them how to use the more effective tools, the computer controlled innovations. True, jobs such as those in the textile industry will be eliminated and several careers will emerge which require an entirely different training program, but that will not be the case with the majority of emerging careers.

Therefore, it is critical that each worker who is part of an industry that will soon become computer-controlled examine the options open: Can retraining occur within the industry or will positions be permanently eliminated? If retraining can occur, the most expedient way to get that training should be determined and pursued. We will all be affected by the computer in our job one way or the other. Determining the affect on each worker's participation in the work force is critical.

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THE VOCATIONAL STUDIES CENTER
University of Wisconsin-Madison

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